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October 11, 1934

Engineering News-Record

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Cooling the Concrete In Boulder Dam

First results of the highly original procedure by which shrinkage in the huge concrete mass is accelerated and localized in groutable joints.

By Byram W. Steele
Designing Engineer on Dams, U. S. Bureau of Reclamation

ALSO IN THIS ISSUE:

Belt Road Bypasses Providence
Camera Copies Maps and Charts 50 Inches Square
Aerodynamics and the Civil Engineer . . . III
Leveling Pavement by Injecting Water Into Subgrade
Long Concrete Arch Viaduct Near Cleveland
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NEW DEPARTURE

Help Industry *by Employing Industry*

WHEN the Construction League recently addressed the President on the unfortunate handling of certain federal construction work, it spoke in the interest of the national recovery for which the President is working and into which he is pouring his talents and energies.

The purpose of the National Industrial Recovery Act is to help industry reestablish more nearly normal conditions in production, employment and profits. One of the industries that is acknowledged to be most vital to general recovery is construction. To its recovery the public works program, fostered and financed by the federal government, is most immediately directed.

But in the administration of that program and in other construction undertaken by various public authorities, with or without the cooperation of the PWA, various practices have prevailed that are not in harmony with the intent and spirit of the Recovery Act. Construction that might have been awarded by contract has been prosecuted by the direct employment of day labor; designing jobs of major importance that might have been entrusted to engineering and architectural organizations of established standing were handled by employment from relief rolls and by a recent order of the Treasury Department no private architects are to be employed on its current building program.

Such measures are unfortunate in that they attempt individual relief at the expense of industrial recovery. In doing this they actually tend to tear down the fabric of industry and to hamper its effort for self-rehabilitation. They conspire to postpone the day so earnestly sought by the President when American industry can again function without further governmental support.

All this results from a failure to recognize that an industry is something more than an aggregation of people engaged on a certain type of work. The construction industry is not just a lot of architects, engineers, contractors and craftsmen any more than a million unorganized men constitute an army. If we are to rehabilitate industry it is not sufficient that we provide some kind of temporary employment to preserve the individuals that compose it; we must respect and preserve also the structure of the industry, maintain its normal processes and utilize its specialized functions.

The establishment of any industry as a going concern requires the investment of years of time, millions of capital and the lives of generations of men. Into the fabric of every profession and industry these elements are woven and it is because they are there that the industry functions smoothly, naturally and efficiently in the service of the community. Those forms and practices that make for most efficient achievement have been derived through a process of evolution that tends to conserve the best. The creative talents and organizing genius of those who thus build an industry are inherent in its structure and practice, and when we disregard that structure or short-circuit that practice, we are tearing down that which measures its stature and its progress as an industry.

Individual employment is but temporary relief for those directly concerned; it does not revive the organism that we call an industry, which alone can provide for the continuous employment of the many who normally serve within its organized ranks.

Today the construction industry relies so heavily for its existence on public works that the rate of its recovery must depend upon the wisdom with which those works are administered. The Construction League does well, therefore, to ask that public officials prosecute them through the normal agencies and processes of the industry. If the established architectural, engineering and contracting organizations, built up over many years, are not enlisted to carry on this program, we shall lose to the tax-paying public the value of their special skill and experience and we shall retard the natural trend to industrial recovery by the degree to which those organizations may be permitted to disintegrate.

Willard Chevalier

ENGINEERING NEWS-RECORD

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In the News:

THE PROPOSED ATLANTIC-GULF CANAL across Florida has been ruled out of the PWA-financing category by a board of engineers that found it far from self-liquidating. The board estimated that it would pay operating cost but that interest charges could not be met.

THE LARGE POWER and irrigation project planned for the Verde River in Arizona received a severe setback when the $4,000,000 tentative PWA allotment to start construction was rescinded. Further studies revealed a cost much higher than originally estimated.

CONSTRUCTION WORK on the Parker Dam unit of the Colorado River Aqueduct has started with Six Companies, Inc., erecting camp buildings and power lines. On the other end of the aqueduct, tunnel driving on the distributing system may be started on the basis of relief work if the action of the district directors is approved by the state relief administration.

FROM BATTLES WITHOUT to revolt within has been the recent lot of the A.F. of L. Trouble centers in the building trades department, where the dozen or so small union members do not want to re-admit the powerful carpenters, bricklayers and electrical workers who seceded several years ago. The annual convention of the A.F. of L. in San Francisco is the battleground.

SO FAR THIS YEAR, according to the Portland Cement Association, contracts have been awarded for 19,007,025 sq.yd. of concrete roads, 10,993,427 sq.yd. of streets and 105,511 sq.yd. of alleys. September contributed nearly 3½ million yards of the road total.

FLOOD-CONTROL WORK on the levee districts of the Mississippi River and tributaries was advanced during August by the placing of more than 11,000,000 cu.yd. of levees, of which 9,805,753 was by contract.

OREGON ENGINEERS voiced endorsement of the newly organized National Society of Professional Engineers at its western conference in Portland last week, and the officers of the Oregon professional group were requested to submit the question of affiliation with the national body to the membership at an early date.

In This Issue:

REFRIGERATED WATER at a temperature of about 40 deg. F. has been circulated through the concrete of Boulder Dam during the last twelve months to extract the heat of hydration and cool the mass to permit immediate grouting of construction joints. The data obtained on operations and results are now sufficient to permit a presentation of informative character.

MR. PAGON'S THIRD ARTICLE on "Aerodynamics and the Civil Engineer" discusses some German wind-tunnel tests on model bridge trusses, which indicate that a drag coefficient of 2.0 for a complete bridge may be expected. In terms of wind pressure this is $0.0051V^2$ lb. per sq.ft.

A CAMERA weighing 14 tons, 31 ft. long and 20 ft. wide, has been designed and built by the U. S. Coast & Geodetic Survey. Notable alike for size and accuracy, it is used to copy maps and charts for actual field-survey work. It assures an accuracy of 0.001 to 0.002 in. on a 50x50-in. negative.

THE IDEA of bypassing roads, to keep through-traffic from congesting city streets, is universally accepted and widely practiced. The efficacy of the special type of bypass road known as "belt road," which connects the ends of roads radiating from a metropolitan center and serves both as a traffic classification and distribution medium, is also coming to be recognized. In such widely separated places as St. Louis, Mo., and Providence, R. I., notable belt roads are under gradual but steady construction. The Providence development is discussed in this issue.

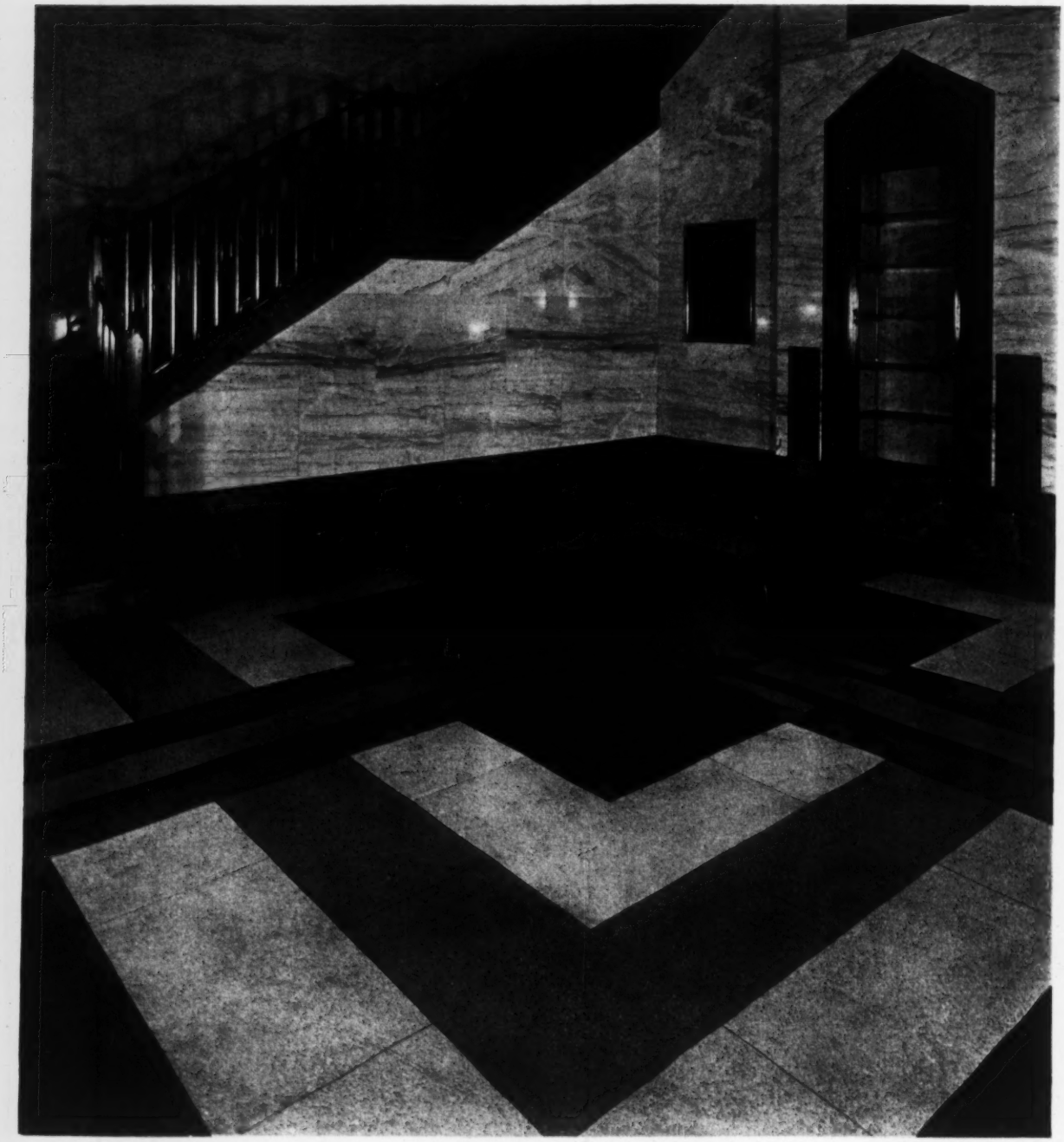
A RESULT OF REPEAL has been a revival of brewery construction, and the heavy tanks required in the brewing process have created some interesting structural problems in the buildings designed to house them. An example occurs in a San Antonio installation, where a connection between deep concrete girders and steel columns was effected by a bracket made by splitting a 36-in. rolled beam.

THE OHIO STATE HIGHWAY DEPARTMENT has built three long open-spandrel concrete-arch viaducts in Cuyahoga County, to serve the traffic of metropolitan Cleveland. The most recent, the Brookpark Viaduct, is distinguished by special architectural treatment, and special provisions for internal air-cooling of mass concrete in the piers.

MADE POSSIBLE through PWA financing totaling $15,000,000, two public power and irrigation projects are being initiated in Nebraska. Near Columbus a power district plans two plants providing a 50,000-kva. installation on the Loup River. In the western end of the state another district will develop 140,000 acre-ft. of storage from the North Platte River as part of a project to include a 34,000-hp. power plant and an irrigation reserve to supplement the late-season supply now available for 176,000 acres of land under cultivation farther down the Platte River. The salient features of both projects are outlined.

UNEVEN MOISTURE CONTENT in the subgrade of Kansas highways has been shown to cause warping and settlement of the concrete slabs. A method of injecting water under the pavement in leveling up the slabs is reviewed.

A fine terrazzo floor to last long and look well



De Paoli Co., Inc., were the terrazzo contractors who installed this Atlas White terrazzo floor. Walter C. Martin was the architect. Both firms of New York City.

HERE'S a testing-ground for a floor! It's in the Samuel Gompers High School for Boys, New York City. What punishment it has to take from scuffling, hurrying feet! This floor takes it and comes up smiling—cheerful—colorful. It's built of fine terrazzo made with Atlas White portland cement. It's a durable floor because it is actually concrete. But because the aggregate is marble and the cement is white, it has beauty in proportion to its strength. This fine terrazzo is placed in *any* design and in *any* colors. The white cement matrix allows perfect color control in combination with vari-colored marbles. Delicate pastels, bright clear tones, deep rich shades of the colors desired are built into the floor precisely as planned. For planning, see our catalog in Sweet's. Any terrazzo contractor will furnish specific details. Or write Universal Atlas Cement Co., *Subsidiary of United States Steel Corporation*, 208 So. La Salle St., Chicago.

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October 11, 1934

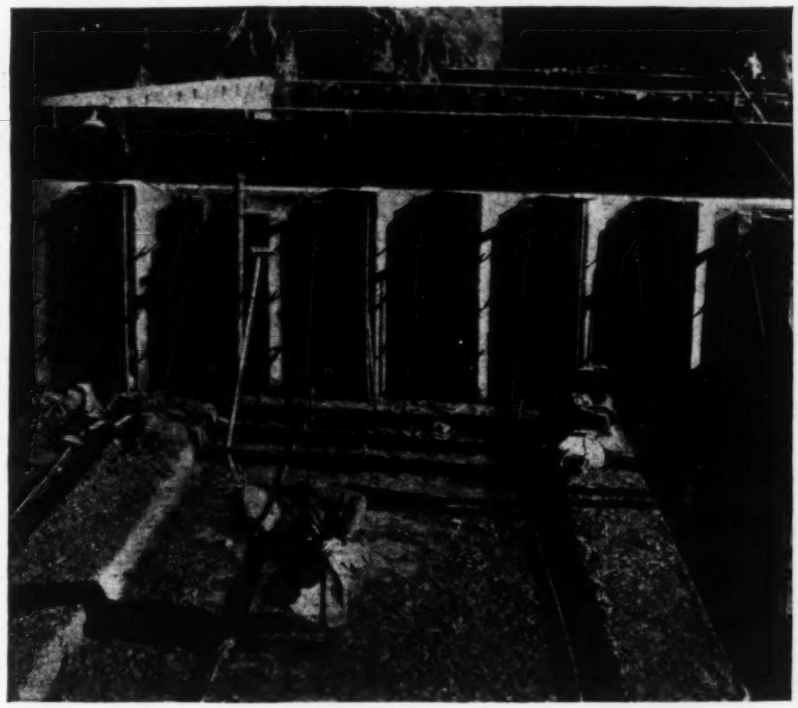

FIG. 1—PIPES of 1-in.-diameter tubing, laid on the surface of each 5-ft. lift, provide for circulating the cooling water through the mass concrete.

Cooling Boulder Dam Concrete

Concrete temperature effectively reduced to conform to planned isotherms—Method described and operating procedure outlined—Grouting of construction joints reviewed

By Byram W. Steele

Designing Engineer on Dams, Bureau of Reclamation, Denver, Colo.

SINCE the Boulder Dam construction program was announced, with the release of specifications in December, 1930, one of the chief features of engineering interest has been the plan for extracting the hydration heat by artificial cooling. Today, the refrigerating plant has been in operation just one year (refrigerated water was turned on Oct. 11, 1933), and this article embodies the first comprehensive and authentic review of cooling operations and results yet published.—EDITOR.

WITH more than two-thirds of the concrete yardage in Boulder Dam placed and cooling and grouting operations following in the programmed sequence, it appears that all major construction difficulties connected with the intricate process of placing, cooling and grouting this unprecedented mass of concrete have been successfully met and the work during the remainder of the construction period will be a matter of routine. The cooling methods that have been gradually developed and the data that have been obtained during a twelve-month period can now be reviewed with sufficient detail to present valuable information on this outstanding feature.

Why is the mass concrete in Boulder Dam being cooled? The answer is to prevent subsequent volume change. Under ordinary conditions of concreting, the largest element of volume change results from the expansion of the concrete, while it heats up during the hardening process and from subsequent shrinkage as the concrete slowly cools. In a very large mass this cooling occupies an extended period, and the concrete continues to shrink and tends to crack in various unexpected and undesired ways.

By artificial cooling this shrinkage is

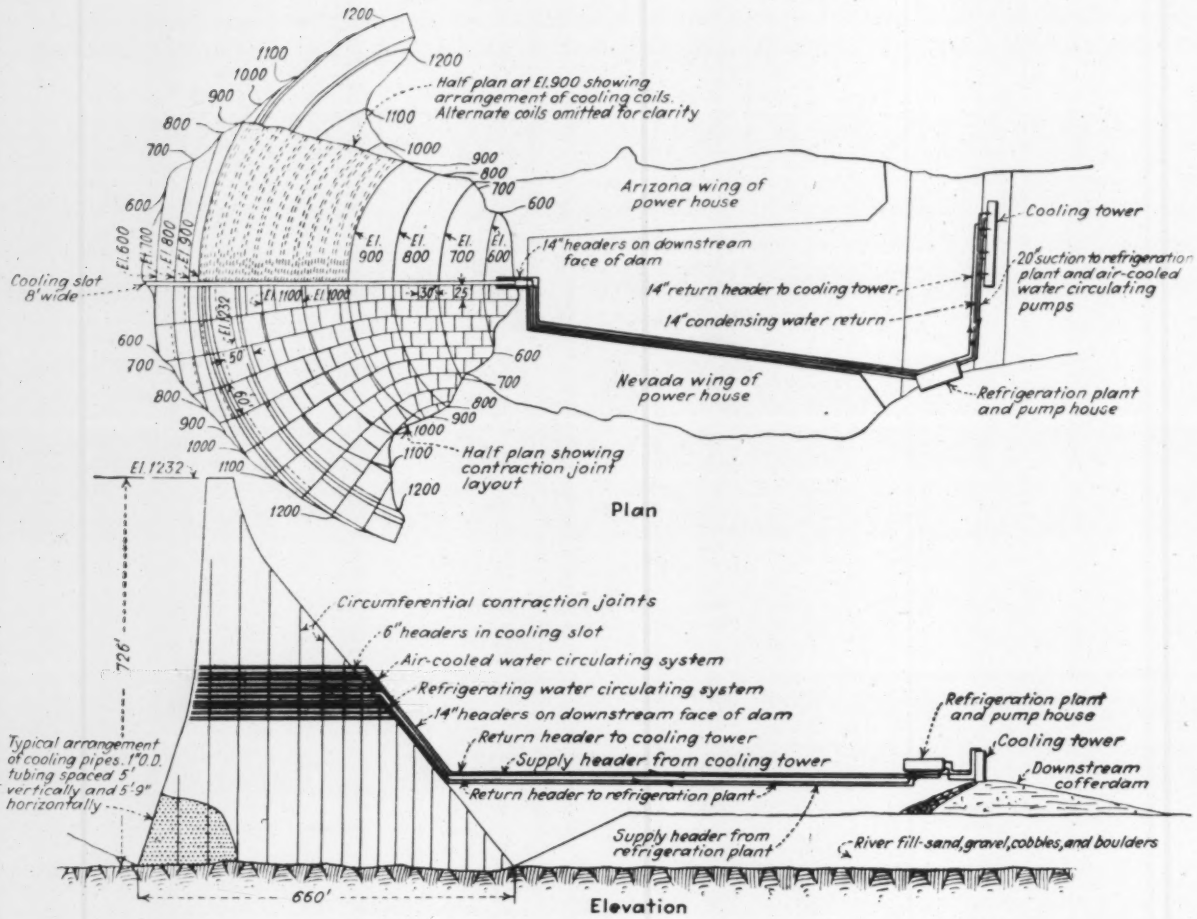
Half plan at El. 900 showing arrangement of cooling coils. Alternate coils omitted for clarity
Arizona wing of power house
Cooling tower
14" headers on downstream face of dam
20" suction to refrigeration plant and air-cooled water circulating pumps
Cooling slot 8' wide
14" return header to cooling tower
14" condensing water return
Nevada wing of power house
Refrigeration plant and pump house
Half plan showing contraction joint layout
Plan
Circumferential contraction joints
6" headers in cooling slot
Air-cooled water circulating system
Refrigerating water circulating system
14" headers on downstream face of dam
Return header to cooling tower
Supply header from cooling tower
Return header to refrigeration plant
Supply header from refrigeration plant
River fill-sand, gravel, cobbles, and boulders
Typical arrangement of cooling pipes. 1" O.D. tubing spaced 5' vertically and 5' 9" horizontally
660'
Elevation

FIG. 2—COOLING SYSTEM from refrigeration plant to the 1-in. tubing in the concrete of the dam shown in a schematic layout.

concentrated in a relatively short period, so that it is virtually complete within a few months. The provision for definite radial and circumferential shrinkage joints within the concrete localizes the change of shape and prevents cracking elsewhere. When these joints are filled with grout, after the cooling is completed, the concrete is converted into a monolithic mass at a time when its volume is a minimum or in that state corresponding to the permanent temperature of the dam.

Volume change in a hydraulic structure is more objectionable than in others, since not only proper distribution of the stress is prevented by the formation of cracks but the leakage resulting from cracking contributes to dissolution of the cement and introduces an expensive and annoying maintenance problem.

Mass-concrete operations on Boulder Dam started June 6, 1933, the circulating of air-cooled water began on Aug. 8, and refrigerated water was introduced on October 11. By Sept. 1, 1934, 2,477,944 cu.yd. of mass concrete have been placed.

Method of cooling

The cooling of the mass of the dam is accomplished by circulating water through pipes buried in the concrete. This refrigeration process is carried on in two stages: (1) circulation of air-cooled water through the pipe system and (2) circulation of refrigerated water through the same pipe system (Fig. 2).

At the time the contract for Boulder Dam was awarded the cooling studies had not progressed to the point where final designs could be incorporated in the specifications and, as a result, provision was made for varying the size and spacing of the cooling pipe as well as other details pertaining to the cooling system. Later studies indicated the desirability of smaller pipes at closer spacing as well as a lower permanent temperature in the upstream part of the dam than in the face exposed to the air. As a result of these studies the pipe size was changed from 2 to 1 in. and the spacing was reduced from 10 to 5 ft. Further, because of the increased extraction of heat necessitated by the lower temperatures desired near the upstream face, the cooling program was divided into two stages, as already noted, the air-cooled water stage being an economic development of the later cooling studies.

The cooling water is conducted from the pumps located in the refrigeration plant, about 800 ft. downstream from the dam, through 14-in. cork-insulated pipes to the downstream face of the dam at the center cooling slot which extends through the dam to the upstream face. The 14-in. main headers continue up the face (Fig. 2), with horizontal 6-in. cork-insulated headers which extend through the slot to the upstream face. From these the loops of 1-in. O. D. 14-gage pipes extend into the concrete. The 1-in. cooling pipes, which are spaced at 5-ft. centers vertically and 5-ft. 9-in. centers horizontally, connect to the 6-in. headers through rubber hose and standard fittings.

The fitting assembly was designed to permit testing each coil for quantity of flow and temperature of the water without interference with the flow through the headers. All pipes buried in the concrete are arranged in coils running in a circumferential direction from the cooling slot to the canyon wall, thence through a 180-deg. bend made in the thin wall tubing and back to the cooling slot. The coils vary in length from 220 to 1,340 ft. with an average length of 513 ft. for the 5,880 coils.

The cooling pipes (Figs. 1 and 3) are laid on the top of each 5-ft. lift after the

concrete has hardened and are anchored by wire loops buried in the concrete while it is still plastic. All sections of the pipe, both within the block and at the contraction joints, have plain ends and are connected by the coupling shown in Fig. 4, which was developed for this purpose. At the contraction joints (Fig. 6) the special coupling serves as an expansion coupling, permitting the tubing to slip in the nipple as the contraction joint opens due to shrinkage of the concrete.

The maximum combined length of pipe in which cooling water was circulated during any one month (see table) was 622,000 lin. ft., or about 118 miles. The total length of all cooling pipe is 3,017,870 ft. or 571 miles.

Temperature recording

The temperature of the mass concrete is obtained from resistance thermometers of two types. One type is buried in the concrete between the cooling pipes, and the other is inserted in the end of the cooling pipe at the slot. The use of the latter type for a temperature determination involves stopping circulation in a coil for 48 hours, to permit the temperature in the concrete surrounding the pipe to equalize, after which the resistance thermometer of special design is inserted into the pipe and the temperature obtained at a distance of 25 to 30 ft. from the face of the cooling slot.

For cooling tower operations, using air-cooled water, the average temperature difference for water entering and leaving the concrete is 7.3 deg. F., the variation being from 4 to 12 deg. F.

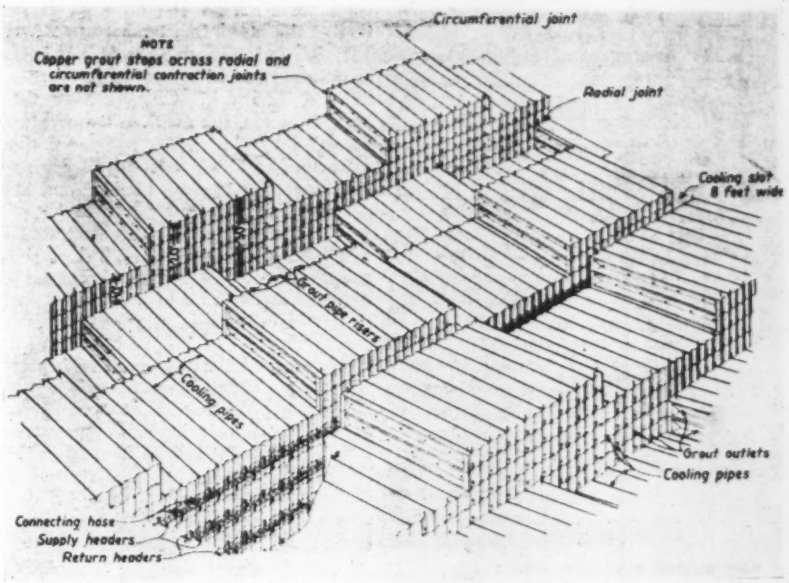

FIG. 3—CONTRACTION-JOINT and cooling-pipe layout in the dam, indicating the columnar form of the concrete sections. The spacing of the 1-in. cooling pipe is 5 ft. vertically and 5 ft. 9 in. horizontally.

For refrigeration-plant operations in which the water is cooled by the ammonia refrigerating process, the average temperature difference is 11.1 deg. F., with a variation from 6.5 to 18.3 deg. F. The system was designed for a flow in each cooling coil of not less than 3 gal. per minute, but data in the table indicate that the average actual flow is over 4 gal. per minute, the variation being from 1.9 to 6.6 gal. per minute for air-cooled water and 4 to 5.5 for refrigerated water.

The refrigeration plant is rated at 825 tons capacity. (One ton of refrigeration is the amount of heat required to melt one ton of ice in 24 hours, or a rate of 200 B.t.u.'s per minute.) This plant capacity plus the effect of the cooling tower combined to produce a value of 1,740 tons of refrigeration in May (see table). It is estimated that the required

DATA ON THE COOLING SYSTEM AND ITS OPERATION BY MONTHS FOR THE FIRST YEAR

Month	Type of Cooling	Elevations	Aver. No. Coils	Length of Coils, Ft.	Aver. Temp. in Mains, Deg. F. Supply	Return	Aver. Flow G.P.M.	Equiv. Tons of Refrig.	Cooling Completed to Aver. El.	Cooling Interrupted, Hours
				1933						
August	A	530–575	56	26,700	72.5	84.5	240	120	...	...
	B	.....	...	.....	.....	.....	.....	.....	...	...
September	A	530–600	136	64,600	68.4	74.4	900	225	...	0
	B	.....	...	.....	.....	.....	.....	.....	...	0
October	A	530–640	297	134,700	71.2	78.4	1,360	410	...	0
	B	530–610	302	143,000	43.5	61.8	1,370	1,045	...	2
November	A	615–660	548	237,000	58.1	64.8	2,340	650	...	168
	B	530–620	380	175,500	40.5	53.4	1,510	810	...	169
December	A	645–670	123	51,900	53.0	57.0	760	125	...	300
	B	530–650	409	187,000	39.4	47.1	2,030	650	575	19
				1934						
January	A	655–680	137	55,400	52.4	56.9	900	170	...	84
	B	580–670	382	168,000	39.0	45.5	1,940	525	630	55
February	A	675–730	338	132,600	57.0	62.0	2,140	445	...	77
	B	580–670	333	146,500	38.4	48.8	1,850	800	645	61
March	A	685–775	413	169,000	61.9	67.8	2,300	560	...	88
	B	625–740	313	128,300	39.3	51.6	1,560	800	660	45
April	A	745–805	560	244,000	66.3	74.2	2,160	710	...	82
	B	660–740	512	204,800	40.4	52.1	2,040	995	695	88
May	A	745–860	862	407,000	70.8	79.8	2,250	845	...	14
	B	685–775	525	215,000	40.5	50.4	2,150	895	740	28
June	A	780–890	815	412,000	70.6	81.3	1,620	720	...	8
	B	715–810	430	187,000	39.7	49.7	1,990	830	770	33
July	A	815–925	712	385,000	77.6	86.8	1,315	505	...	9
	B	745–840	373	173,000	39.3	51.0	1,810	880	805	16
August	A	850–965	684	397,700	80.9	90.6	1,352	545	...	10
	B	765–875	360	177,800	39.7	52.4	1,590	840	840	10

A = Cooling-tower operation (started Aug. 8, 1933)
B = Refrigeration-plant operation (started Oct. 11, 1933)

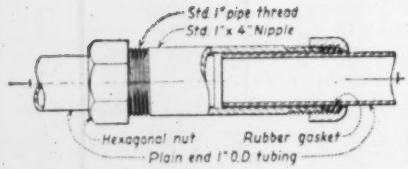

FIG. 4—EXPANSION COUPLING used to connect 1-in. cooling pipe.

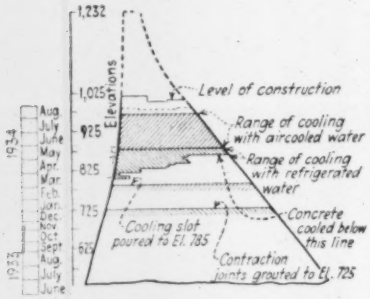

FIG. 5—OPERATIONS of concrete placing, cooling, slot filling and grouting are maintained in this general relation as construction advances.

cooling of the concrete in Boulder Dam will involve the extraction of about 170 billion B.t.u.'s, of which a little over two-thirds had been removed by Sept. 1, 48 billion being removed with air-cooled water and 71 billion with refrigerated water. It is anticipated that before hot weather next year the cooling of the dam will be completed and the contraction joints grouted.

The amount of heat that is extracted at any point in the dam is the excess over that indicated by the isotherms in Fig. 7. This excess is not all due to the heat liberated in the hardening process but is a combination of the heat stored in the aggregates at the time the concrete was poured and the heat of hydration, the percentage of each varying with the season of the year.

The desired variation in temperature between the upstream and downstream faces of the dam (Fig. 7) is based on exhaustive studies along this line, in which it was demonstrated that the water in the reservoir below the penstock intakes (El. 900) will approach the temperature of water at maximum density, or 39.3 deg. F., and that the concrete near the downstream face, like the rock in the canyon walls, will approach mean annual air temperature for this locality, or 72 deg. F.

Concrete temperatures

Three typical curves of temperature plotted against time as recorded by resistance thermometers buried in the mass concrete are shown in Fig. 8; No. 1 curve is for normal cement, which was used for a short time during the early construction period before low-heat cement was available, No. 2 curve is for a blend of 40 per cent normal and 60 per cent low-heat cement, and No. 3 is for low-heat cement. The initial temperatures were 89, 58 and 60 deg., respectively; the maximum temperatures were 131, 97 and 92.5 deg.; and the corresponding rises in temperature were 42, 39 and 32.5 deg. Compared to these typical curves, the average temperatures recorded by almost 200 resistance thermometers were 41, 38 and 32 deg., respectively, for normal, blended and low-heat cements.

Specimens of mass concrete tested in adiabatic calorimeters for 28 days show temperature rises for these classes of cements of 64, 53 and 46 deg., respectively. Under adiabatic conditions of curing there is no loss of heat from the specimen, and the only gain in heat results from chemical action during the hardening process. Thus, a comparison of field and calorimeter temperatures indicates that the loss of heat from each lift of concrete during the interval between pours, which averages 4.7 days, is roughly one-third of the total heat generated. These differences in temperature serve to illustrate the differences in the volume-change characteristics of the three cements and constitute a rough measure of the value of the low-heat cement from the standpoint of economy in cooling operations.

Contraction-joint grouting

Unless the contraction-joint openings are filled with grout of satisfactory density, the value of the mass-concrete cooling and shrinking process is largely lost. To accomplish this result, a system of pipes with outlets in the contraction joints at intervals of 30 to 50 sq.ft. is embedded in the concrete adjacent to the construction joints. These outlet pipes are connected to headers that run to grouting galleries in the body of the dam and also to both faces of the dam. Thus a complete circulating system is provided for distributing grout and, also, for drawing off water and thin grout not suitable to leave in the joints.

Because of the distance between faces in the lower part of the dam the radial joints are divided into two parts by a vertical grout stop near the center of the dam, to facilitate the grouting operations in the lower sections. The circumferential joints in a radial tier of blocks are connected to one header with the exception of the joint that tapers out on the downstream face. This joint is served by an individual header and grouted separately.

PREVIOUS ARTICLES ON BOULDER DAM CONCRETE

Tentative cement specifications, Nov. 10, 1932, p. 558.
Research program, Dec. 15, 1932, p. 724.
Mass-concrete design, Dec. 21, 1933, p. 737.
Concrete-placing methods, Dec. 21, 1933, p. 743.
Refrigeration plant, Dec. 21, 1933, p. 748.

FIG. 6—AT THE FORMS the cooling-pipe coupling is covered to make the end of the pipe available for connecting after the form has been raised.

The contraction-joint grouting operation is being carried up in 50-ft. lifts as fast as the concrete is cooled and the cooling slot concreted. For the lower part of the dam, grout was mixed in a seven-sack concrete mixer set up in gallery (El. 705) on the Arizona side of the dam. From the mixer the grout was discharged into an agitator through a screen. The agitator consisted of a vertical open-top tank 3 ft. in diameter by 2 ft. deep, with an air-driven motor on a vertical shaft that had two blades set close to the bottom of the tank. From the agitator tank the grout flowed by gravity through a 2-in. pipe line to the lower galleries from which the grouting for the first two 50-ft. lifts was done. Another similar agitator and a 10x3x 10-in. duplex-piston displacement pump are set up in the lower galleries. As the work progresses upward, the details in connection with the location and operation of the equipment will be changed as required. Near the top of the dam grouting equipment will be placed either on platforms on the downstream face of the dam or on the crest of the dam.

The radial contraction joints in each lift are grouted first, and after a 7- to 10-day interval the circumferential joints in the same lift are grouted. The plan so far has been to group the joints into sets that will enable the work to be carried on most efficiently. The actual filling of a joint or set of joints is done by gravity flow from the last agitator. The pump, so arranged as to be quickly hooked into the line, is used only when the joint is nearly full, to drive off surplus water and thin grout and to consolidate the film of grout in the joint. Various grout pressures are used, depending on conditions. Pressures up to 300 lb. per sq.in. have been used in some joints to accomplish desired results, but a pressure of 100 lb. has been demonstrated as sufficient to drive the surplus water into the concrete on either side

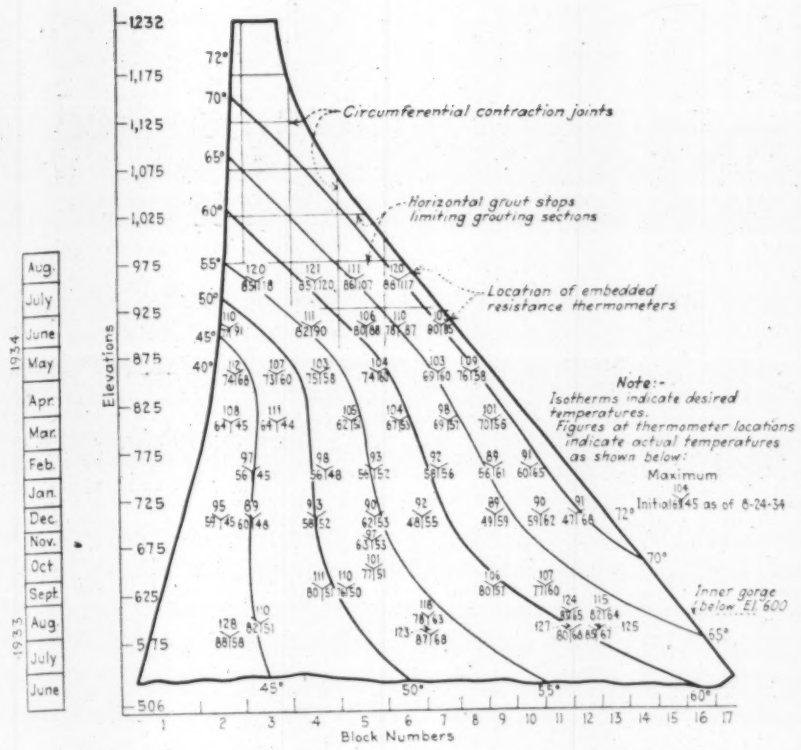
Circumferential contraction joints
Horizontal grout stops limiting grouting sections
Location of embedded resistance thermometers
Note:- Isotherms indicate desired temperatures. Figures at thermometer locations indicate actual temperatures as shown below: Maximum Initial as of 8-24-34
Inner gorge below El. 600
Elevations
Block Numbers
1934
1933

FIG. 7—CROSS-SECTION OF THE DAM, showing isotherms that indicate the desired final temperatures, with data on the concrete temperature when placed, the maximum reached and the result of cooling.

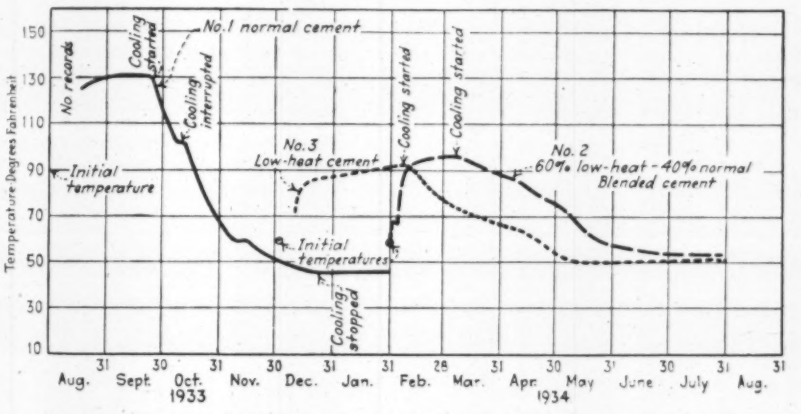

FIG. 8—TEMPERATURE CURVES typical of the heating and cooling of normal, blended and low-heat cement. The curves are typical of the data obtained from scores of recording thermometers placed in the structure.

of the joint and give a grout film of satisfactory density.

To date, an average of one sack of cement has been required for about 100 sq.ft. of contraction-joint area, the grout varying in water-cement ratio from 0.75 to 1.00. Assuming that the cement, which is screened through a 200-mesh screen to increase its penetration into fine seams, is 50 per cent voids and retains about 50 per cent of the mixing water, the remainder being driven into the concrete adjacent to the joint, it appears that the joints will average from 0.10 to 0.12 in. in width. The width, of course, is subject to temperature variations between the two faces of the dam and to the amount of heat extracted. An inspection trip through the galleries in the dam emphasizes the uniformity of the contraction-joint openings and the absence of other cracks that usually accompany volume change of the magnitude produced by the cooling operations in Boulder Dam.

The grout is confined in the contraction joints by means of copper grout stops placed across the joints and anchored in the concrete on either side. The radial and circumferential joints are separated by grout stops placed across the circumferential joints near their junction with the radial joints. In addition to those vertical grout stops, there are horizontal grout stops in every joint at 50-ft. intervals. Thus it will be seen that the contraction-joint openings in the dam are divided into 50-ft. lifts with varying radial and circumferential dimensions.

Some difficulty is experienced with leakage of grout from the contraction-joint spaces during the grouting operation, but the method of procedure has recently been improved sufficiently so that it is believed a satisfactory film of grout of the desired consistency is being secured in all contraction joints.

In dams constructed in recent years by the bureau it has been common practice to paint the exposed side of each contraction joint with a thin coat of water-gas tar, to prevent bond between the two sides of the joint and to guarantee that the joint would open as built and not break out in a ragged plane along which grout would travel with difficulty. A series of experiments with concrete blocks having painted and unpainted contact surfaces simulating an actual contraction joint demonstrated that the unpainted surfaces would separate and provide a clean smooth joint along which grout would readily travel. As soon as this had been demonstrated, painting of contraction joints at Boulder Dam was discontinued, and field results have fully justified the conclusions reached in the experiments.

The circumferential joints are so shaped that the resultant inclined pressures in the dam are normal or parallel to the contact faces of the joint, which tends to minimize the shearing stresses on the grout film in the joint.

So far, no attempt has been made to obtain a systematic check on the width of contraction-joint openings in the dam because this was done in experiments at Owyhee Dam. The data obtained at Owyhee Dam and in the laboratory give assurance that adequate joint openings for grouting purposes are being obtained at Boulder Dam. However, near the top of the dam it is planned to embed suitable apparatus for measuring the width of joint openings at various points during the cooling operation and for obtaining, in future years, data relative to the seasonal temperature effect on the contact area between the arch voussoirs.

Organization

All research and design work is under the direction of J. L. Savage, chief designing engineer. Engineering and construction work is under the general direction of R. F. Walter, chief engineer, with headquarters at Denver. Dr. Elwood Mead, with headquarters at Washington, D. C., is Commissioner of the Bureau of Reclamation.

Contract for the construction of Boulder Dam is held by Six Companies, Inc. A complete statement of the engineering and contracting personnel appeared in *ENR*, Dec. 21, 1933, p. 758.

Aerodynamics and the Civil Engineer—III

Drag Coefficients for Structures Studied in Wind-Tunnel Model Tests

A coefficient of 2.0 for a model of a complete bridge, indicating a resistance in lb. per sq.ft. of 0.0051 V^2, is shown by German tests—Coefficients for normal and oblique winds for single girders and for pairs of girders also determined

By W. Watters Pagon
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IN THIS THIRD ARTICLE of the series Mr. Pagon reports some German tests which furnish new data on the effect of shape of structure and wind direction on the drag coefficient and in turn on the resistance that the structure offers to a steady wind. The first article discussing aerodynamic principles in general was published March 15, 1934, p. 348. The second article, which described the solution of a vibration problem in some tall stacks by means of reasoning along aerodynamic lines, appeared July 12, 1934, p. 41. —EDITOR.

STRUCTURES, and specifically bridges, are a composite of flat surfaces in three rectangular directions: (1) vertical webs of plate girders, stringers, joists, truss members, etc.; (2) floor beams and vertical truss members; and (3) floor system, horizontal flange plates, webs of truss members, etc. Present practice in bridge design bases the wind drag, or pressure, on the area of all metal that shows once in projection, and then, in various specifications, increases this by a factor of 1½ or 2. These points are recited in order that the following discussion may be correlated with matters of common practice.

In the first paper of this series (*ENR*, March 15, 1934, p. 348) the drag of flat plates, square and rectangular, and the effect of shape and size were discussed. In this connection, a most interesting set of tests has been made in the wind tunnel at Göttingen, Germany, by Prandtl and Betz, (Ergeb. der Aerod. Versuchsanstalt zu Gött., III Lieferung), on small-model lattice girders and structural shapes. The tests bring out a number of interesting points which are not commonly known. The following discussion is based on the report of these tests.

Terms defined

The resistance or force coefficient, measured parallel to the wind when the wind is normal to the surface (the "normal drag coefficient," C_d), is the total resistance, divided by the stagnation pressure q and by the area of the object. For oblique wind, the coefficient of normal pressure will be called C_x; that in a vertical direction, C_z; and that in a lateral direction, C_y. The wind direction is defined by the angle between the wind and the normal to the surface—i.e., for $\alpha = 0$ deg. the wind is normal to the surface.

Two different areas will be considered for the normal drag coefficient: (1) the actual projected area of all members, gussets, etc.; and (2), the total area enclosed by the periphery of the top and bottom chords and the end posts. In a plate girder the total area is, of course, the true area. On the other hand, tests on screens have shown that part of the wind fails to pass through the openings, and it is a common occurrence that snow is deposited along a snow fence, as part of the wind is deflected over the top. Hence, the total area of a lattice truss is also significant. The first area, which is the actual projected area, will be called A, and the second area A'. The ratio A/A' gives the relation of solid area to total area, and measures the "porosity."

Test girders

Five different girders were tested, although No. 1 was later modified. All had a length of 43 in., a center depth of 5.71 in. and an end depth of 3.35 in., with straight top chord and curved bottom chord. Therefore, the area A' for all of them was 195 sq.in. Girder No. 1 had a solid web 0.36 in. thick, and the thickness of the members of the lattice girders was the same. Girder No. 1a (modified from No. 1) had coverplates that extended out 0.4 in. and were 0.04 in. thick. Girder No. 2 was a Howe truss type with sixteen panels, the depths of the members in the plane of the web being as shown in Fig. 1. Its solid area, A, was 122 sq.in., or 62.7 per cent of A'. Girder No. 3 was a Warren truss type of four panels, with center and end verticals; area A was 68.6 sq.in., or 35.4 per cent of A'. Girder No. 4 was a Warren truss type of six panels with seven verticals, one at each top-chord joint; area A, 84.8 sq.in., or 43.5 per cent of A'. Girder No. 5 was like No. 4 except that the members were formed of structural shapes instead of flat plates, and its area A was 89.0 sq.in., or 45.8 per cent of A'.

In a preliminary test, at wind velocities of about 33, 49, 66, 82 and 99 f.p.s. (ft. per sec.) the force coefficients, C_d, for normal wind showed a variation of only 2, 3, 5, 1 and 1 per cent respectively; hence in all of the following tests a velocity of about 66 f.p.s. was used in order to minimize difficulties caused by bending of the models under wind pressure. The average normal force coefficients for the girders were respectively 1.27, 1.57, 1.65, 1.53 and 1.47; for girder No. 1a the coefficient was 1.38. If these be plotted against A/A', a rough trend is shown which may be expressed as $C_d = 1.25 + 0.60 (1 - A/A')$ for this series of girders with a length/depth ratio of about 7.5. In other words, the more open the web, the higher the coefficient. This is probably due to the fact that long narrow flat plates tend to have high coefficients, increasing to 2.0 for an infinite length width ratio. Had the models been larger, somewhat higher coefficients would probably have been found, as noted in *Engineering News-Record*, March 15, 1934, in the discussion of the effect of size of plate. However, in spite of the higher coefficient, an open web provides less exposed area of structure upon which the unit pressure expressed by the coefficient acts.

Effect of wind direction on drag

Since wind direction varies continuously, it is necessary to know how such changes affect drag. Tests were made, therefore, with wind oblique from above and oblique from one end, giving all three drag coefficients. For single girders there was little change in the normal drag coefficient with changes in the angle α as shown in Table I. Up to 20 deg. from above, the change is about 8 per cent, and at 45 deg. the average change is 20 per cent or less.

It should be noted that all of these coefficients are computed by dividing the actual component of drag by the frontal solid area A, which gives an artificial (and low) value for the two transverse components. It will also be noted that in some cases girder No. 4 shows higher drags C_x than girder No. 5, and vice versa, depending upon the effect of the wind angle on the structural shapes.

Shielding—To determine the effect of interference between girders, pairs of

all five types were tested in normal wind but at different spacings between the two girders of a pair. The results are given in Table 2.

Up to 21.7 in., or about three times the depth of the girder, rear girder No. 1 has a *forward drag* or *suction*. Up to 2.0 in., or about ⅛ of the depth, girders Nos. 2, 3 and 4 also have suction. Girder No. 3 is the most open of all types, followed by Nos. 4 and 5, and it will be seen that rear girder No. 3 receives the greatest (positive) drag in all tests, followed in order by Nos. 4 and 5. This indicates that an open-lattice girder has a minimum shielding effect on a mate behind it. The total drag for the pairs of girders should be noted and may be compared with the drag of cylinders and disks in tandem as found by Eiffel.

In order to correlate these experiments with actual conditions, a rough criterion may be developed to show the relation of girder spacing and size of members. For example, a highway bridge with trusses 24 ft. on centers and chord members 1.5 ft. deep, or a ratio of 16, has about the same ratio as for girders of type No. 3, spaced 7.9 in. It will be seen that for such a case, even for normal wind, where the shielding is considered to be maximum, the total drag on two girders is greater than $2q$—i.e., greater than $51\left(\frac{V}{100}\right)^2$ lb. per sq.ft. for velocity V in m.p.h

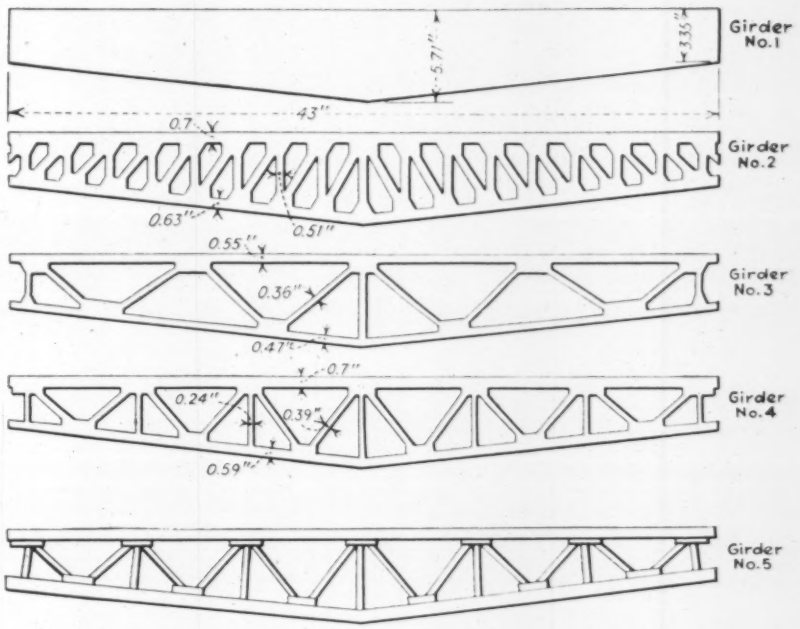


FIG. 1—TYPES OF MODEL GIRDERS tested in the wind tunnel to determine drag coefficients for various wind directions.

To determine the shielding effect in oblique wind, tests were made of a pair of girders of type No 5, spaced 15.8 in. apart, with the results shown in Table 3. These clearly indicate how little shielding effect there is after the wind is 10 deg. or more from the horizontal, although for wind oblique in the horizontal plane there is naturally a greater shielding effect. The combined pressures normal to the girder exceed $2q$ in almost all cases.

TABLE 1—EFFECT OF WIND DIRECTION ON DRAG (SINGLE GIRDERS)

	Wind Oblique from Above						Wind Oblique from the End					
	No. 1		No. 4		No. 5		No. 1		No. 4		No. 5	
α	C_x	C_z	C_x	C_z	C_x	C_z	C_x	C_y	C_x	C_y	C_x	C_y
0°	1.27	—.03	1.55	—.04	1.47	—.04	1.27	—.03	1.54	—.03	1.46	—.03
5°	1.30	—.01	1.55	—.04	1.49	—.07	1.26	—.01	1.53	—.03	1.45	—.01
10°	1.25	.00	1.55	—.06	1.48	—.06	1.26	+.01	1.50	—.02	1.45	—.01
15°	1.25	.00	1.54	—.07	1.41	—.17	1.26	+.03	1.49	.00	1.45	—.01
20°	1.24	.00	1.51	—.07	1.42	—.18	1.26	+.04	1.47	+.03	1.43	+.01
25°	1.22	.00	1.49	—.05	1.44	—.04	1.28	+.07	1.44	+.02	1.40	+.04
30°	1.21	.00	1.44	—.05	1.45	+.05	1.32	+.10	1.38	+.12	1.32	+.09
35°	1.18	+.01	1.39	+.09	1.44	+.17	1.34	+.11	1.31	+.16	1.21	+.16
40°	1.16	.00	1.32	+.23	1.40	+.27	1.27	+.17	1.23	+.19	1.11	+.20
45°	1.10	+.01	1.24	+.31	1.33	+.39	1.19	+.22	1.14	+.23	1.00	+.24

α is zero when the wind is normal to the plane of the web. C_x is normal to the web; C_y is horizontal and in the web plane; C_z is vertical.

TABLE 2—EFFECT OF WIND DIRECTION ON DRAG (GIRDERS IN PAIRS) C_d FOR NORMAL WIND

Spacing, In.	Forward Girder					Rear Girder				
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 1	No. 2	No. 3	No. 4	No. 5
2.0	1.31			1.84	1.44	—.06	—.04	—.02	—.08	+.07
2.2		1.41	1.60							
3.9	1.33	1.43	1.46	1.53	1.36	—.09	+.21	+.46	+.20	+.35
7.9	1.35	1.41	1.46	1.43	1.33	—.16	+.31	+.86	+.59	+.51
11.8				1.43	1.36	—.19	+.34			
15.8	1.32	1.45	1.53	1.46	1.37	—.16	+.38	+1.10	+.85	+.65
19.7					1.39	—.04	+.45			
23.7	1.25	1.48	1.55	1.49	1.40	+.10	+.51	+1.15	+.92	+.73
27.6						+.27	+.57			
31.6	1.21	1.49	1.57	1.51	1.41	+.45	+.62	+1.19	+.97	+.87

TABLE 3—EFFECT OF WIND DIRECTION ON DRAG (GIRDERS IN PAIRS) WIND OBLIQUE

	Wind Oblique from Above				Wind Oblique from the End			
	Forward Girder		Rear Girder		Forward Girder		Rear Girder	
α, Deg.	C_x	C_z	C_x	C_z	C_x	C_y	C_x	C_y
0	1.42	—.01	0.67	—.06	1.39	—.03	0.60	—.02
5	1.43	—.04	0.84	—.10	1.39	—.02	0.71	+.01
10	1.43	—.05	1.12	—.13	1.38	.00	0.79	+.02
15	1.37	—.13	1.32	—.21	1.38	+.01	0.84	+.04
20	1.36	—.18	1.43	—.13	1.36	.05	0.88	.06
25	1.39	.00	1.47	.00	1.34	.04	0.90	.11
30	1.44	+.02	1.46	.09	1.25	.08	0.88	.14
35		.0	1.45	.19	1.16	.13	0.85	.17
40	1.37	.15	1.42	.30	1.04	.18	0.81	.21
45	1.30	.42	1.34	.42	0.96	.22	0.76	.24

Test of a complete bridge model

A complete bridge model was next tested, using a pair of girders, No. 5, and a deck 5.5 in. wide. In order that the parts could be weighed separately, a small gap was left between each two parts, hence the total drag of the entire unit does not agree exactly with the sum of the component parts. The width of the deck is nearly equal to the depth of the girders, and its area is in the ratio $\frac{5.5'' \times 43.0''}{89.0} = 2.67$. In Table 5, as previously, all coefficients are based on the frontal solid area A of one girder.

Tests of structural shapes

In order to ascertain the effect of the form of the structural shapes commonly used in bridgework, seven shapes were formed of wood, each having a length of 59 in. These shapes were so installed across the width of the wind tunnel that they could be rotated, thus obtaining the two rectangular drag components at 10-deg. intervals. The forces so obtained were considered to be those that would act on a piece of infinite length—i.e. for two-dimensional flow. The coefficients, in two rectangular directions x and z, would act on the respective areas A_x and A_z; i.e., each co-

TABLE 4—EFFECT OF WIND DIRECTION ON DRAG (STRUCTURAL SHAPES)

Shape No. 1 $A_x = A_z = 303$ sq.in			Shape No. 2 $A_x = 303$ $A_z = 151$			Shape No. 3 $A_x = 303$ $A_z = 145$			Shape No. 4 $A_x = 279$ $A_z = 303$			Shape No. 5 $A_x = 303$ $A_z = 140$			Shape No. 6 $A_x = A_z = 303$			Shape No. 7 $A_x = 443$ A_z		
α	C_x	C_z	α	C_x	C_z	α	C_x	C_z	α	C_x	C_z	α	C_x	C_z	α	C_x	C_z	α	C_x	C_z
45°	—1.35	1.45	0°	—0.18	1.99	—10°	+0.29	2.04	—10°	—0.07	2.03	—10°	—0.07	1.54	—10	—0.38	1.50	—10°	—0.05	
35°	—1.03	1.68	20°	—0.70	1.77	0°	0.08	2.04	0°	—0.05	2.01	0°	—0.13	1.51	0°	+.04	1.76	0°	—0.04	
25	—0.54	1.75	40°	+1.12	1.63	+10	0.00	2.08	+10	—0.02	2.05	10	—0.20	1.59	10	0.38	1.64	10	—0.22	
—15	+0.43	1.75	50	1.56	1.44	20	—0.29	2.04	20	—0.13	1.97	20	—0.26	1.60	20	0.72	1.29	20	—0.59	
—5	0.42	1.85	60	1.68	+1.13	30	+0.19	1.89	30	—0.37	1.70	30	—0.13	1.65	30	1.11	0.68	30	+0.68	
+5	0.05	2.03	80	1.68	—0.16	40	0.97	1.96	40	+0.28	1.45	40	—0.11	1.56	40	0.92	0.79	40	1.63	
15	—0.13	2.03	90	1.62	—0.24	50	1.47	1.87	50	1.24	0.86	50	—0.24	1.32	50	0.81	0.89	50	2.04	
25	0.00	1.83	100	1.72	—0.02	60	1.78	1.49	60	1.65	+0.30	60	+0.54	+0.91	60	0.43	1.16	60	2.18	
35	—1.01	1.78	120	1.72	+0.15	70	2.02	+0.80	70	1.78	—0.47	70	1.45	+0.24	70	1.22	0.82	70	2.07	
45	—0.67	1.90	130	+0.74	—1.10	80	1.58	—0.52	80	1.68	—1.61	80	1.54	—0.46	80	1.59	+0.50	80	1.78	
55	+0.35	+1.25	140	—0.04	—1.52	85	1.56	—0.27	90	1.98	—1.28	90	1.45	—0.95	90	1.75	+0.18	90	1.96	
65	1.27	—0.01	160	—2.02	—1.76	90	1.81	0.00	100	2.00	—1.13	100	+1.65	—0.78	100	1.57	—0.23	100	1.74	
75	1.68	—1.28	170	—1.90	—1.94	100	1.62	+0.39	110	1.94	—1.04	110	1.98	—0.68	110	1.15	—0.56	110	2.06	
85	1.80	—2.08	180	—1.92	—1.92				120	2.00	—1.04	120	2.14	—0.66	120	0.86	—0.77	120	2.07	
95	1.85	—2.05	190	—1.84	—1.92				130	2.10	—1.04	130	2.29	—0.60	130	0.83	—0.70	130	2.03	
105	1.83	—1.95	200	—1.84	—1.92				140	2.24	—1.11	140	2.19	—0.33	140	0.79	—0.57	140	+1.78	
115	1.72	—1.93	220	—1.56	—1.82				150	2.32	—0.81	150	2.02	—0.73				150	+1.24	
125	1.76	—1.89	230	—1.60	—1.80				160	2.10	—0.75	160	1.32	—1.14				160	—0.27	
130	1.71	—1.73	240	—1.70	—1.88				170	+1.92	—0.99	170	+0.67	—1.40				170	0.00	
135	1.69	—1.69	260	—3.46	—2.03				180	+0.52	—1.55	180	+0.11	—1.46				180	+0.30	
145	1.76	—1.78	280	0.92	—0.15				190	1.89	—1.71	190	—0.43	—1.42				190	0.29	
150	1.88	—1.79	290	+0.18	+1.28															
155	1.92	—1.81	300	+0.12	1.30															
			310	+0.32	1.57															
			320	—0.02	1.85															
			330	—0.02	1.96															
			340	+0.02	2.01															
			360	—0.14	2.02															

TABLE 5—EFFECT OF WIND DIRECTION ON DRAG (COMPLETE BRIDGE, WITH NO. 5 GIRDERS), WIND OBLIQUE FROM ABOVE

	Forward Girder		Rear Girder		Deck		Total	
	C_x	C_z	C_x	C_z	C_x	C_z	C_x	C_z
0°	1.35	.07	0.51	—.02	—.18	0.91	1.63	0.83
2.5°					—.09	0.68		
5°	1.32	—.05	0.62	+.01	—.10	0.85	1.74	0.71
10°	1.27	—.02	0.73	+.02	—.09	1.20	1.80	1.06
15°	1.21	.00	0.89	+.01	—.09	1.70	1.84	1.45
20°	1.10	+.03	1.02	—.04	—.14	2.03	1.86	1.80
25°	0.98	.17	1.10	—.08	—.18	2.35	1.84	2.19
30°	0.80	.34	1.14	—.07	—.16	2.53	1.76	2.50
35°	0.68	.43	1.15	—.02	—.23	2.60	1.67	2.92
40°	0.56	.49	1.15	+.08	—.17	2.71	1.52	3.28
45°	0.22	.51	1.10	+.20	—.15	2.72	1.32	3.56

C_z for the deck is measured normal to the girder webs, and C_z is measured vertically—i.e. normal to the deck. Also, in order that the coefficients may be totaled for the entire bridge, C_x and C_z are based upon the area A of one girder. True values of C_z for the deck may be obtained by dividing the tabulated figures by 2.67, as noted in the text.

efficient multiplied by q and by its respective area, will give the component of drag in that direction. In Fig. 2, which shows the various shapes tested, the angle α is shown opposite each shape, the arrow representing the wind, and positive angles are measured counterclockwise.

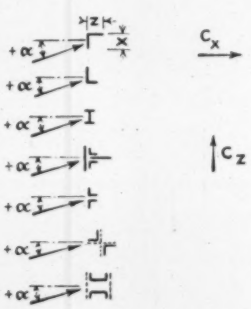
Models No. 1 to 4 were continuous members, unmodified; No. 5 was continuous, with two separators spaced symmetrically at 29.8-in. centers; No. 6 had two battens in each direction, and the common edges were spaced 29.8 ft. on centers; No. 7 consisted of two channels with legs outstanding, 3.15 in. back to back, with two battens on each side spaced at 29.8-in. centers. The computed areas for Nos. 5 and 6 are based on the over-all width, including the space between the angles; for No. 7, the total area out to out of legs, including the space between the backs of the channels, is used.

From the results given in Table 4 it appears that the wind flow in the wind tunnel may not have been quite symmetrical because, at equal positive and negative angles on the symmetrical shapes, the coefficients differ somewhat. It is significant, nevertheless, how rapidly the coefficients change for a small angular change; e.g., in No. 1 the change is from +1.25 to —1.28 within 20 deg.; in No. 4, from +1.92 to —1.89 within 20 deg. In the latter, the section is acting as a flat plate edgewise to the wind, hence for a slight change of angle below or above 180 deg. the "angle of attack" changes from positive to negative, giving corresponding sign to the coefficient. A similar effect occurs for No. 2 at 280 deg. Near 115 deg. in No. 4 the values of C_z are high, evidently because of the damming effect of the flange plate.

It will be helpful here to refer back to the first article of this series (*ENR* March 15, 1934) for a comparison with long narrow rectangular plates whose coefficient is about 2.00. These structural shape models exceed that value in the case of No. 4, but generally they approximate it so that 2.0 seems to be a fair value to use generally. This indicates a resistance of about $51\left(\frac{V}{100}\right)^2$ lb. per sq.ft. for V in m.p.h. and in a *steady* wind.

FIG. 2—DATA ON WOOD MODELS of structural shapes tested to determine their respective drag coefficients.

			x		z
Shape No. 1	*Equal leg angle*	5.1"	×	5.1"
Shape No. 2	*Unequal leg angle*	5.1"	×	2.6"
Shape No. 3	*I-beam section*	5.1"	×	2.4"
Shape No. 4	*Tee section*	4.7"	×	5.1"
Shape No. 5	*Two angles b. to b.*	5.1"	×	2.4"
Shape No. 6	*2 angles, star-section*	5.1"	×	5.1"
Shape No. 7	*2 channels battened*	7.5"	×	4.7"



Welding in Poland

In a paper at the International Congress for Steel Development in London last June, Stefan Bryla, professor in the Technical College of Lwow, Poland, stated that the development of steel framework construction on a large scale in Poland dates from only about five years ago, and that the development of welding has contributed greatly to this increase in the use of steel. Starting in 1929, the following all-welded jobs have been completed: the Treasury Chamber, Katowice, six stories, 180 tons of steel; Post Office Savings Bank, Warsaw, seven stories, 800 tons of steel; two mill buildings in Ostrowice involving 84 and 120 tons of steel, respectively; Military Fund's Quarters, Warsaw, six stories, 700 tons of steel; Military-Navy Building, Warsaw, five stories, 200 tons of steel; library, Cracow, eight stories, 550 tons of steel. In addition, a sixteen-story apartment building (Prudential House) in Warsaw, involving 1,200 tons of steel, shop-welded and field-riveted, has been built.

Belt Road Sorts Out Traffic Bypassing Providence

Great system of radial highways centering in Rhode Island capitol is being connected outside congested city streets by stage construction of a four-lane belt highway

FIG. 1—ROADSIDE PICNIC GROUND typical of recreation areas being developed along the four-lane belt highway around Providence, R. I.

STAGE DEVELOPMENT of a four-lane belt road involving heavy bridge construction is a major project of the Rhode Island highway department for improving traffic conditions at Providence. Beginning north of the capitol city, the road swings west, south and east in an irregular half circle, with its ends at the Massachusetts state line where connection is made with the main-road system of the Bay State. The route is in part new location and in part follows existing roads, which can be reconstructed or widened for an ultimate 40-ft. pavement. At present only two lanes are or will be paved, but roadway width is being developed for four lanes of pavement, the bridges are being built with 40-ft. roadways, and land is being secured for ultimate grade separations, roadside developments and other second-stage improvements.

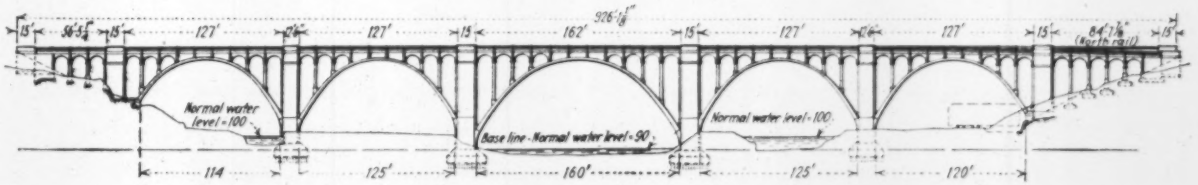
A glance at the map (Fig. 4) shows that Providence is the focus of an exceptional number of radial roads with no very well-defined connection with each other except through the city. Narragansett Bay practically severs the state from north to south. Except for a ferry at Newport, the east and west parts of the state have no road connection nearer than Providence. The same barrier also exists to east and west travel between Connecticut and the popular resort regions of eastern Rhode Island and the southeastern cape and island resorts of Massachusetts. Providence and all north Rhode Island have many industries, and the roads carry a heavy business traffic in addition to the through pleasure travel. Essentially all of Rhode Island may be said to have metropolitan traffic conditions on its state roads.

As shown on the map (Fig. 4) the planned belt line is 34.7 miles long, including 19.1 miles of existing road paved to a width of two lanes and 15.6 miles of road to be constructed. Beginning at the north, the condition of the sections in sequence is as follows: from the Boston Post Road in Massachusetts west to Diamond Hill Road in Rhode Island, 4 miles (2½ miles in Massachusetts and 1½ miles in Rhode Island) of preliminary surveys and line studies are being made for final location by the two state highway departments. The next 1.7 miles to Mendon Road is a bituminous macadam paved for two lanes and graded for four lanes. This brings the belt line to the present year's construction, except the Blackstone River Bridge (¼ mile) at Ashton, which is described later.

Including the bridge, there are 6½ miles of new construction from Mendon Road to Farnum Pike, of which 2 miles to Louisquisset Pike have been graded for a 40-ft. pavement and 4½ miles to Farnum Pike have been graded for four lanes and paved for two lanes with bituminous macadam. This section of the road includes the Stillwater Viaduct over the Woonasquatucket River (*ENR*, May 3, 1934, p. 555).

From Farnum Pike to Cranston St. there are 20-ft. bituminous macadam roads that can be widened to 40 ft. as traffic demands; this stretch is 11.3 miles long. For 3 miles south from Cranston St. to the Bald Hill Road the new route is along an old bituminous road which requires realignment in detail and a new surface. A new route, 2.3 miles across country, takes the belt line from Bald Hill Road to Post Road, and from there to Warwick Ave. a 40-ft. concrete road runs past the state airport for 1.6 miles. From Warwick Ave. an approach would be made to a proposed new high-level bridge over the Providence River. The east approach to the bridge would tie into the state highway system at Kent Corner in East Providence, making the total distance from Warwick Ave. to Kent Corner about 4.3 miles.

FIG. 2—ASHTON VIADUCT is one of three major bridge structures on Providence, R. I., belt line highway. A long high-level steel bridge over the Providence River is also included.



Road construction

With the minor exception of the airport road, the belt road construction adheres to the predominating practice of the Rhode Island highway engineers in employing bituminous macadam. Tak-

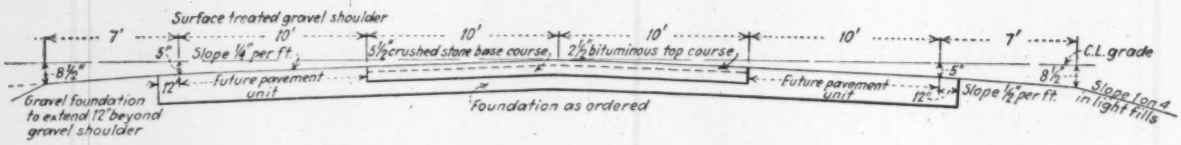
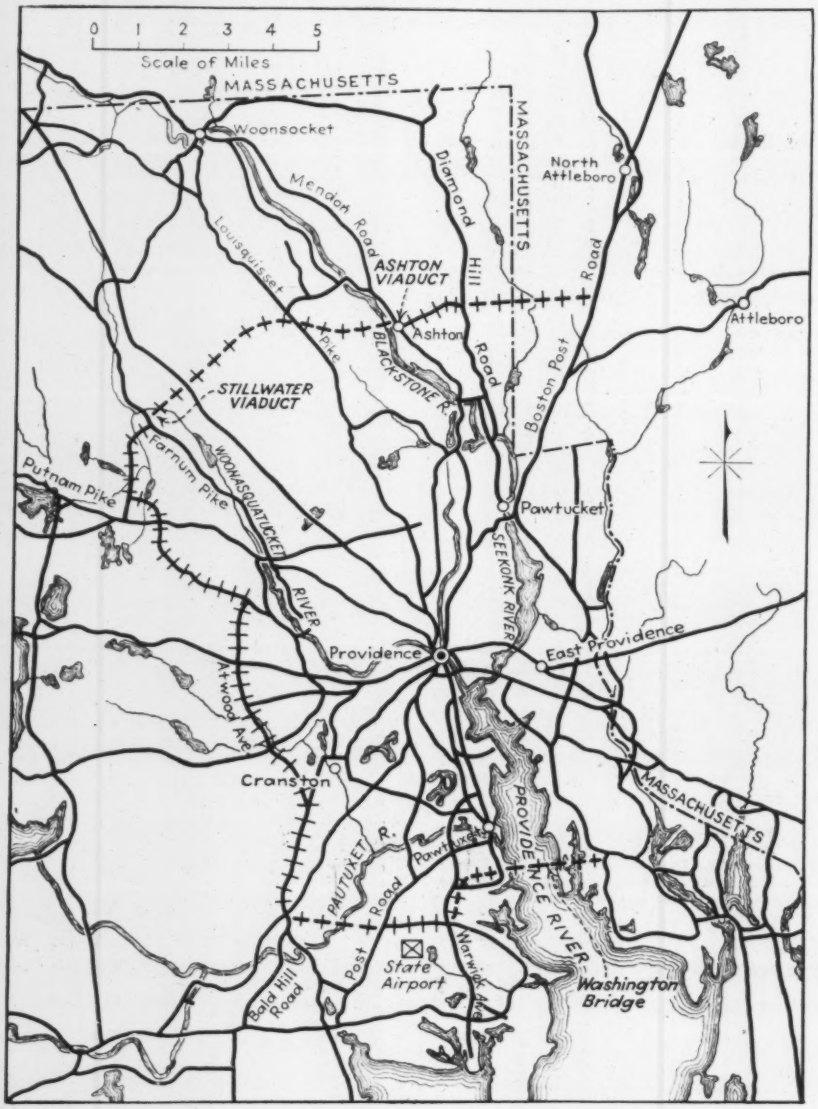


FIG. 3—TYPICAL SECTION of bituminous-macadam grade and first two-lane unit of pavement for belt highway around Providence, R. I.

ing the new work between Mendon Road and Farnum Pike as an example, a typical cross-section is as shown by Fig. 3. The only element requiring explanation is the sub-base labeled "foundation as ordered." In Rhode Island bituminous-macadam practice the sub-base or foundation for the surfacing courses is a designed and carefully constructed part of the road structure; it may vary in depth from station to station or be the same for long stretches where subsoil conditions are constant, and the structure may be gravel fill alone or gravel or crushed stone on a telford base of field stone. In actuality the foundation is as ordered by the road engineer as the grading discloses the conditions.

The bituminous-macadam surfacing indicated on Fig. 3 is standard state road practice and has been described in many articles, including *Engineering News-Record* of Oct. 29, 1931, p. 692.

FIG. 4—BELT ROAD in process of stage construction bypasses through traffic and interconnects large number of heavy traffic radial roads entering Providence.



The fundamental elements are excellent materials and careful workmanship. A hard tough stone is demanded, its sizes are rigidly controlled, and it is required to be meticulously clean. Until recenlty, trap rock was specified, but with the donation of federal funds under the Recovery Act the practice has been interfered with and an open specification demanded. In this, however, the requirements for screen sizes, cleanliness, coefficient of wear, toughness and specific gravity that were established for trap rock remain in force.

Bridge construction

The bridge work called for by the complete belt-road project includes three major structures. One is the Stillwater Viaduct, already referred to, which at present is the largest road-bridge structure in Rhode Island. This distinction will disappear with the construction of the bridge at Ashton, which is logically next in order for construction. At last, complete precedence in size and cost will be taken over by the high-level structure over Providence River. At present this major structure has been only tentatively thought out. Including steel approaches, a structure about 8,600 ft. long will be required, with a channel-span clearance for large-vessel navigation. It will cost probably around $4,500,000.

The Ashton Viaduct has been fully designed and can be put under construction as soon as funds are provided. As shown by Fig. 2, the bridge is an open-spandrel multiple-arch structure of reinforced concrete, 926 ft. long, with a 40-ft. roadway between curbs and a curb and sidewalk width on each side of 5 ft. 2 in. The arches consist of two parallel ribs, each carrying two rows of spandrel columns between which are sprung arches in the planes of the parapets and also across the bridge under the floor slab. The bridge crosses a deep valley in which are Blackstone River, Blackstone Canal, a mill canal, a railway and several roads. At the east end the south parapet is flared out for a roadway approach for a future grade separaton of Mendon Road (Fig. 4) and the belt route. Main-span dimensions are shown by Fig. 2.

Roadside development

Coordinated with the purely structural elements, the belt line road planning inculdes a comprehensive scheme of roadside development. In part, this is provided for in the original grading, which is so conducted as to leave slopes shaped up for immediate planting. But largely the provision has been pur-

chase of right-of-way and adjacent land areas for future development. Some of this second-stage work, particularly slope planting, is going ahead under contracts simultaneous with those for roadbuilding proper, but in general it is contemplated as a following operation. The work includes grassing slopes, planting of shrubs and vines, cultivating lawns and flower beds at intersections and construction of picnic grounds. In general, a type of landscaping is being practiced which is a little more artificial than the mere development of wild growths fitted to wholly rural locations because much of the belt line is through existing or developing residential areas.

The road being close to a large city population, particular attention is being given to the provision of accommodations for picnicking parties where the city scenes and noises are shut out. An example of the types of these recreation plots as they are being developed is shown by Fig. 1. They are, however, largely different in arrangement, and while most of them are of small area like the one illustrated, some are planned that have quite the semblance of woodland parks. This development, as stated, will be largely second-stage construction, but it is planned for from the beginning by providing the necessary land areas. The care of these plots is a part of the road maintenance operations of the highway department.

The planning and construction of the belt road are under the direction of the state board of public roads, of which George H. Henderson is chief engineer.

Huge 50-In. Precision Camera for Copying Maps and Charts

Coast & Geodetic Survey develops unusual equipment to speed production and increase accuracy in reproducing large charts for use in re-survey work

By J. H. Hawley
Acting Director, U.S. Coast & Geodetic Survey, Washington, D.C.

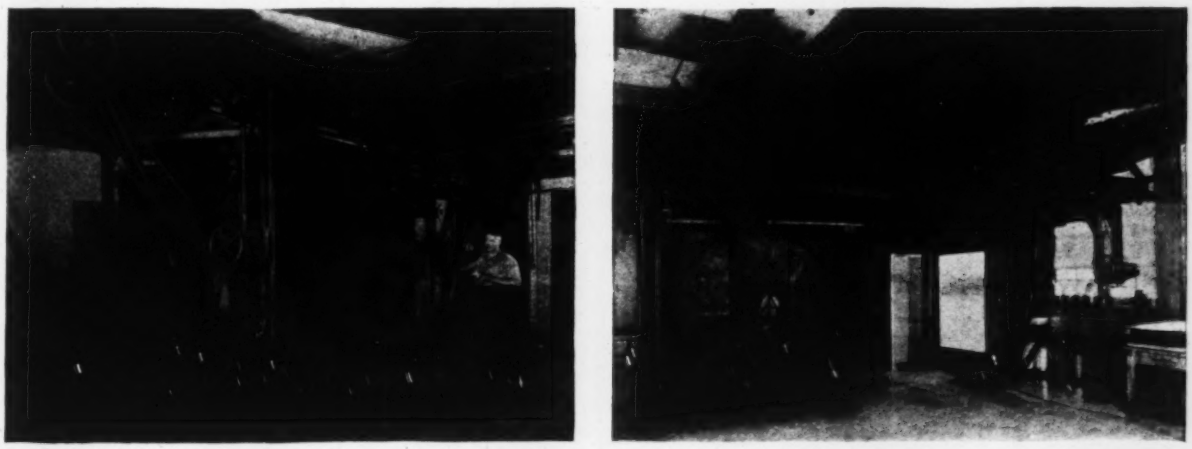
A CAMERA weighing 14 tons and capable of reproducing the largest-size charts or survey sheets (50x50 in.) with an accuracy of 0.001 or 0.002 in. has been developed by the U. S. Coast & Geodetic Survey and was recently placed in service in the basement of the Department of Commerce Building in Washington.

The new camera is one of the largest in the world, being 31 ft. long and 20 ft. wide. Since it is capable of reproducing the largest-size chart on one negative, a considerable saving of time will be effected over the previous system, where two or four negatives were necessary.

The necessity for the extreme precision of reproduction made possible by the new camera occurs in chart construction previous to the final printing. To eliminate errors caused by paper distortion, special aluminum sheets, paper-mounted or lacquered, have been used in recent yaers for field surveys. For the same reason, paper glued to thin aluminum sheets has been used for a number of years in chart compilations in order to avoid the extra work of making allowances for the hydroscopic changes in the paper while plotting.

Generally the problem of making complete resurveys is much simpler than keeping the surveys revised to date at practicable expense, particularly along a changeable coast with harbors under continuous development. The revision work is essentially a problem of replacement of parts. In order to do this job with high efficiency, it is necessary that the former surveys be reproduced so accurately on the aluminum sheets sent to the field that only the changed areas need be resurveyed to a junction with the unchanged. It is apparent that much time would be lost if it were necessary to allow continually for distortion in the reproduction of the former work. With precise reproduction it is possible to recognize and correct small errors in the former surveys and thus to improve the accuracy of the whole instead of having the accuracy gradually deteriorate as it does when reproductions are made on paper subject to distortions. The new precision camera of the Coast and Geodetic Survey is an important link in this modern development of cartography and revision surveying.

From an engineering standpoint the construction of the camera is interesting because of the difficulty of maintaining the required precision in a machine 31 ft. long, with copyboard and lens carriages weighing nearly a ton rolling along its framework. The main members of the camera frame are 27-in., 85-lb. I-beams. They hold the difference in deflection at the various settings of the one-ton carriages to less than 0.01 in., the supports for the frame being carried directly on the building foundation. The frame is suspended at three points with groups of chains that free the camera from any effects due to settlement or horizontal vibrations of the



PRECISION CAMERA for copying work uses negatives up to 50 in. square. In the left view the operator at the lens carriage is directing the camera at the main copying board. Behind him is the door to the dark room, which encloses the plate end of the camera. The view at the right shows the auxiliary copying board for making direct instead of reversed negatives. Note the prism mirror suspended in front of the lens to make this possible.

building. Provision has been made for cork pads to damp out vertical vibrations.

The lens and copyboards run on two tracks fixed to the frame by screws with lock nuts that provide for both horizontal and vertical adjustment of the tracks at intervals of about 18 in. The guide track is aligned both vertically and horizontally, and the other track in a vertical direction only. The positions of the copyboards and lens board are set by scales fixed to the guide tracks and read by optical verniers in magnifying periscopes to hundredths of a millimeter. Provision is also made for ground glass focusing by a set of gear and chain controls from the plate end of the camera.

The fixed or plate end of the camera has been partitioned off to form a dark room in which the plates may be sensitized, exposed and developed without requiring plateholders. One of the limiting errors of the camera is the selection of plate glass sufficiently flat for the photographs. Plates are usually warped about 10/1,000 of an inch or so, being concave on one side and convex on the other. Thus far photographs have been made on selected flat plates, but a device is being constructed to press against the unsensitized, convex side of the plates, thus holding them to the required flatness. Very little pressure is needed for this.

The survey sheets and maps to be photographed are held between a sheet of specially selected water white plate glass and a rubber blanket. The atmospheric pressure of the air outside the blanket and glass then holds the copy flat with a minimum of deflection of the glass. A system of telescoping sheet-steel tubes is used instead of a bellows, both for greater durability and to avoid a varying tension on the lens board which so large a bellows would entail.

Certain processes of map reproduction require a direct instead of the usual reversed negative. An auxiliary copyboard and a reversing mirror of steel have been provided for this work. The reversing mirror is mounted on a point-line plane support which permits removal and replacement in front of the lens without disturbing the delicate adjustment.

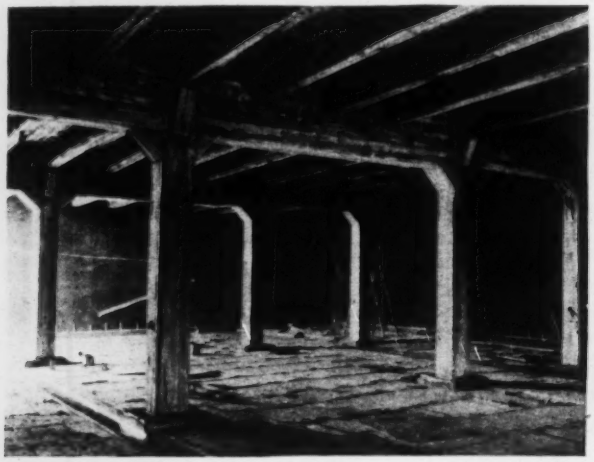
Nearly two years were required for the design, construction and adjustment of the camera. The original design sketches and specifications were prepared by Lieut. O. S. Reading, U. S. Coast and Geodetic Survey, who also had charge of the project. Much valuable information was obtained from the optical instrument section of the U. S. Bureau of Standards. The overhead suspension was adopted from the cameras of the Geological Survey. Preliminary designs were prepared at the Naval Gun Factory Sight Shop. Final design and construction were done under contract by the American Instrument Co., Washington, D. C.

Heavy Construction Required for Brewery Stockhouse

Deep pedestal foundations, novel connections of concrete girders to steel column cores and special slab reinforcing feature new structure in San Antonio, Texas

By Homer M. Matthews
Matthews and Kenan, Structural Engineers, San Antonio, Texas

BECAUSE of the heavy concentrated loads of steel storage tanks, equivalent to 750 lb. per sq.ft., unusually heavy girders and columns were necessary for the stockhouse portion of the new 75,000-bbl. plant of the Sabinas Brewing Co., Inc., in San Antonio, Tex. Tied and spiral reinforced-concrete columns were used in the two upper stories of the three-story structure, but steel-cored columns were required in the first story. An unusual detail was developed for the connection of these steel cores to the deep concrete girders. Pedestal-type piers were put down with a special drilling machine, and the pedestal opening was then excavated by hand. In constructing the building three weeks' time was saved by using high-early-strength cement in all beams and floor slabs above the ground floor.



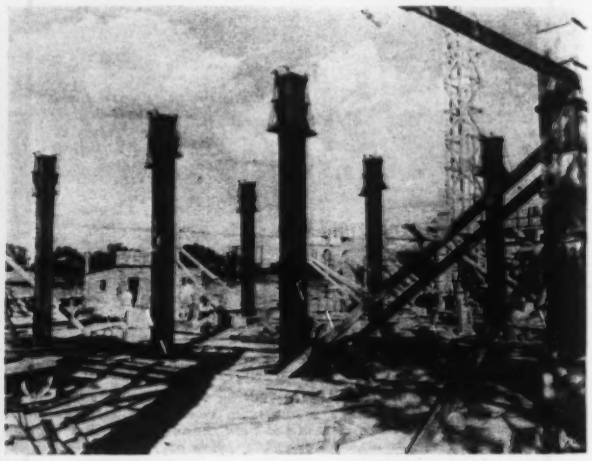


FIG. 1—TWO VIEWS of the first floor of brewery stockhouse in San Antonio, showing (left) completed structure before installation of the tanks and (right) the steel cores of the columns with the heavy bracket connections for the second-floor girders.

Pedestal piers

Column loads equivalent to those of a 30-story office building necessitated special foundation construction. The 45-ft. depth to an adequate bearing stratum together with a 3-ft. layer of water-bearing sand 20 ft. below the surface complicated the foundation problem. A pedestal-pile type of pier was selected.

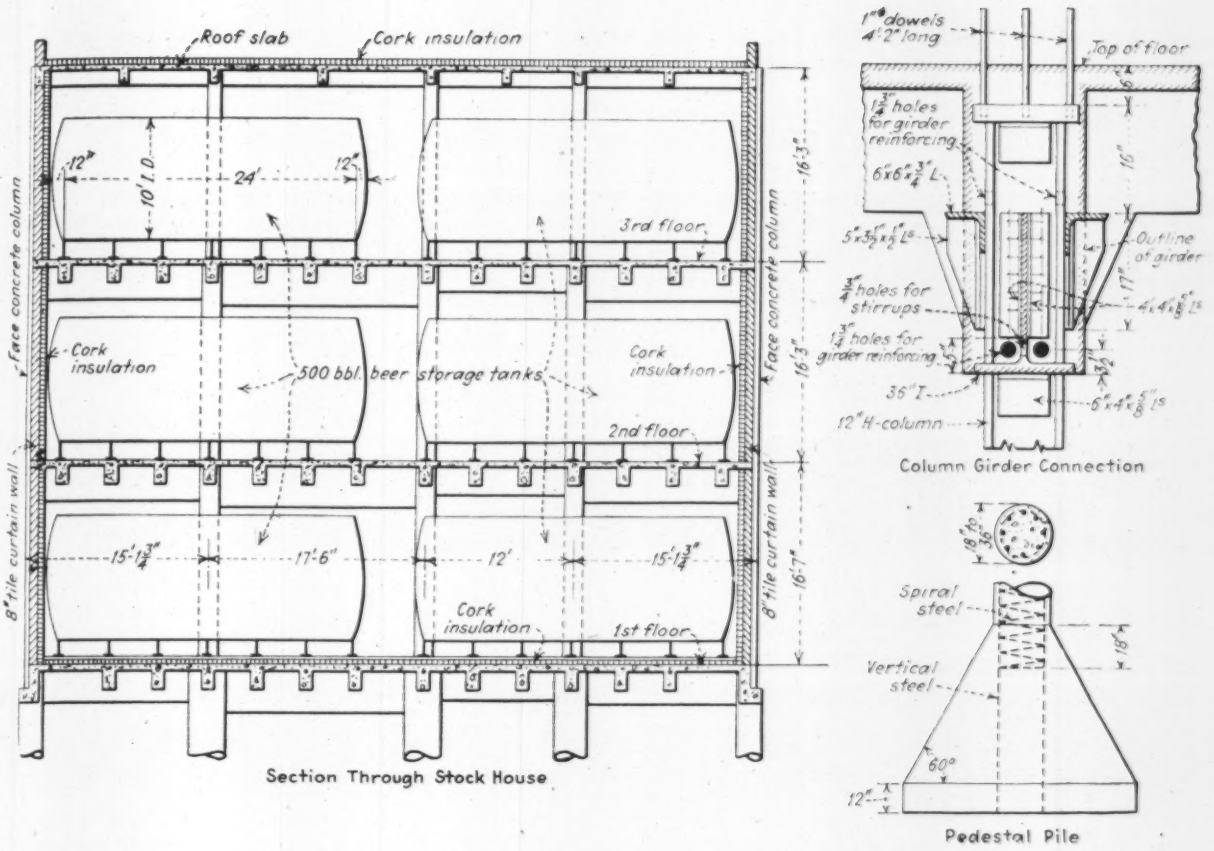


FIG. 2—STOCKHOUSE of brewery, showing, in the section, how the tank supports are carried by the floor beams and, in detail, the pedestal-type foundations and the unusual connection between the concrete girders and the steel column cores.

The shafts of the piers, which varied from 18 to 36 in. in diameter, were first drilled by machine several feet into the clay below the water-bearing stratum. Steel casings a few inches larger than the columns were then placed and driven tightly into the clay. The water was then pumped out, and the drilling continued until the required depth was reached. The excavation for the shaft bases was completed by hand, Mexican labor being experienced in working in small areas with short-handled picks and shovels and without forced ventilation.

When the base excavation was complete, the spiral reinforcement for the shafts was set with a 90-ft. boom on the drilling machine. Shaft and base were then concreted and the steel shell was pulled, to be used in the construction of other shafts.

Heavy concrete framing

The tank arrangement influenced the spacing of the columns, and columns were limited to 18 in. square because of the 18-in. width of girders required. This limitation of column size caused no complications in the second and third floors, but in the first floor the load involved was greater than the capacity of an 18-in. square spiral reinforced column. Larger square spiral columns could not be used; and a double spiral rectangular column was objectionable to the owner. With these possibilities eliminated, a composite column consisting of a structural-steel core encased in concrete was chosen.

In devising a connection between the steel column cores and the reinforced-concrete girders having reactions at the second floor of nearly 150,000 lb., special brackets cut from a 36-in. I-beam were devised. Details of this connection are shown in Fig. 2. These brackets were fastened to the web of the columns without eccentricity by means of angles as shown. It will be noted that the brackets are located within the concrete section of the girders instead of below it and that they are placed in the direction of the least radius of gyration of the column. As a result, the moment caused by a large difference in the end reactions of the girders, acting as eccentric loads, is distributed along the riveted angle connection to the column web within the concrete girder section, thereby eliminating column bending. A possible tendency for the web of the bracket to split the girder is precluded by using three ⅝-in. stirrups threaded through open holes in the bracket web just above the flange. Also, the flange of the bracket was designed as a cantilever for the resulting uniform load of the reaction.

In order to provide full continuity of beam and girder compression steel at the supports, holes were provided through the web and flanges of the columns. Continuity of tension steel at the supports was conveniently handled by locating the column top slab 6 in. below the second-floor level, thereby permitting steel from both directions to pass over.

Beams were located under the tank legs, to relieve the floor slab of heavy concentrated loads. These beams varied from 9½x16 in. to 11½x22 in. in section, according to their location, span and loading. The girders varied from 18x30 in. to 18x44 in. The beam sections were held constant for all floors in order to simplify the formwork.

A saving was made in the floor-slab reinforcement by using only one type of bent bar and no straight bars. Each bar was bent down at the inflection point, run straight for two spans and then bent up and down again. Alternate bars were turned end for end, thus providing the proper amount of positive and negative steel reinforcement with one type of bar.

Personnel

Structural engineers on the work were Matthews & Kenan. Charles T. Aubin was the architect, Lloyd D. Roger the mechanical engineer, Hill & Combs the foundation contractor, and Ed. W. Oeffinger contractor on superstructure, all of San Antonio.

Adding Water to Subgrade Levels up Pavement

Concrete pavement warped and settled out of crown, and profile restored by injecting water by well points inserted horizontally into subgrade

By Harold Allen and A. W. Johnson
Engineer of Materials and Field Soil Engineer, Kansas State Highway Commission, Topeka, Kan.

CONCRETE PAVEMENT SLABS distorted at the ends in such a manner as to produce high joints first appeared in Kansas in 1928. Since that time high joints have developed on other projects in different parts of the state. Little was done until 1931 in the way of thorough investigation of this form of pavement distortion, except to take precise levels to study the phenomenon itself. But in 1931 a study of soils was begun in the state. In 1931 and 1932 a great number of soil tests were made in the manner outlined by the United States Bureau of Public Roads to determine the characteristics of the subgrade soils of pavements that had warped. The results of these tests indicated that these subgrade soils possessed characteristics that closely approached or fell within the *a 7* group.

The next step was to study the actual action of these subgrade soils when subjected to different conditions of moistur and compaction. A series of tests in the laboratory of these subgrade soils having a moisture content and degree of compaction similar to that found in the field showed a volume change from absorbed water sufficient in magnitude and force to cause the observed distortion. Later a small test slab was built in the laboratory on an *a 7* subgrade soil prepared to approximate field conditions, and water was admitted through the joints to the subgrade. The results of this test further pointed to the fact that this form of pavement distortion was caused by uplift of the slab ends by volume change of the subgrade soil as water entered through open leaky joints and cracks in the pavement.

Based on the results of these tests and observations, it appeared obvious that if the distortion were caused altogether or substantially by subgrade movement due to unequal moisture distribution from water entering joints and cracks, it should be possible to level the slabs by equalizing the moisture content by introducing water into the subgrade between joints and cracks.

A section of pavement (FAP 301 H, route U. S. 40S) in Ellis County was selected for such a test and experiment. This project, 10 miles in length, was built in 1931, using a 9-6-9-in. x 20-ft. cross-section. The concrete was made of a sand-gravel mix, using 5 gal. of water per sack of cement. The slab was reinforced with 49-lb. mesh placed 2 in. from the surface and carried across three intermediate contraction joints equally spaced between 1-in. poured expansion joints placed at 120-ft. intervals. This project was one of the most recent to develop objectionable distortions and one upon which much research work had already been done to establish the cause of the distortion, which included both high joints and loss of crown of the pavement. Prior to admitting the water, observation holes were drilled through the pavement at different locations in the section. A thorough study of the existing conditions of moisture content and density of the subgrade soil was then made at the various locations for future comparison with those to be taken after lifting the slab by means of introducing water into the subgrade.

Several different methods of introducing water into the subgrade were considered. It was not desirable to close the pavement to traffic. Therefore, it was necessary to devise some method so that the experiment could be carried on without interrupting the flow of traffic. It was decided to use perforated pipe that could be driven under the pavement.

Well points (Fig. 1) were attached to the pipes, and the assembly was pushed under the pavement by means of a small two-man pipe jack similar to those used under city streets.

Knowledge of the existing moisture content of the subgrade at different depths and locations on the slab was used to determine the position of the pipe line. Since the moisture that entered the joints had not, except in rare cases, traveled laterally more than 10 ft., and since the drier soil lay in the upper 2 ft. under the slab, the pipes were placed at a depth of 7 to 10 in. below the pavement and were spaced laterally at 5-ft. intervals beginning at a point 10 ft. from each joint. The plan of the pipe layout is shown in Fig. 2.

Pipes were connected to a common header as shown in Fig. 1. The header was connected directly by means of a flexible hose to a tank mounted on a truck. It was at first thought desirable to use a considerable head to force water into the subgrade more rapidly. This, however, resulted in the loss of water through leakage in the shoulders and along the edge of the slab. The head of water finally adopted was one that varied from 24 in. with a full tank to 6 in. when the tank was empty. On a second slab now being lifted a common stock tank is being used for the storage of water. The head used on the second slab varies from a maximum of 24 in. when the tank is full to 2 in. when the tank is empty.

Much of the water used the first day was lost into the shoulders because of the higher head and manner of installing the pipes. Before jacking the pipes under the slab, trenches were dug through the shoulder. The earth re-

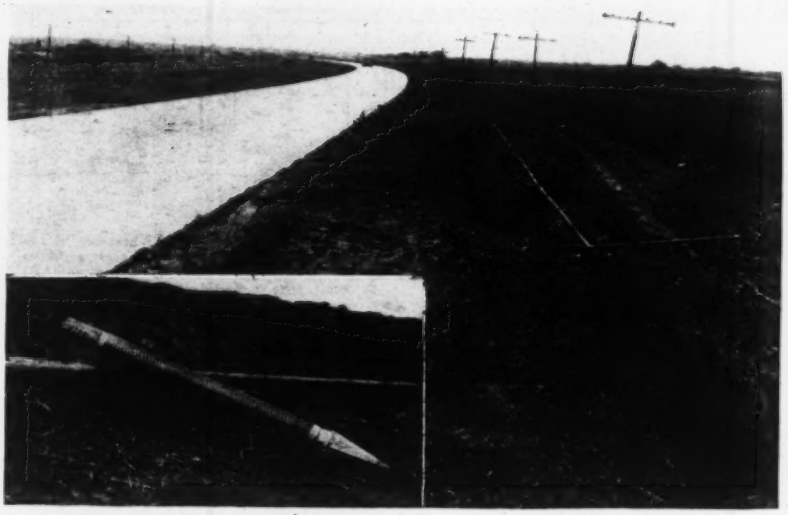


FIG. 1—WELL POINTS SYSTEM for injecting water into subgrade to correct warping and settling of concrete pavement.

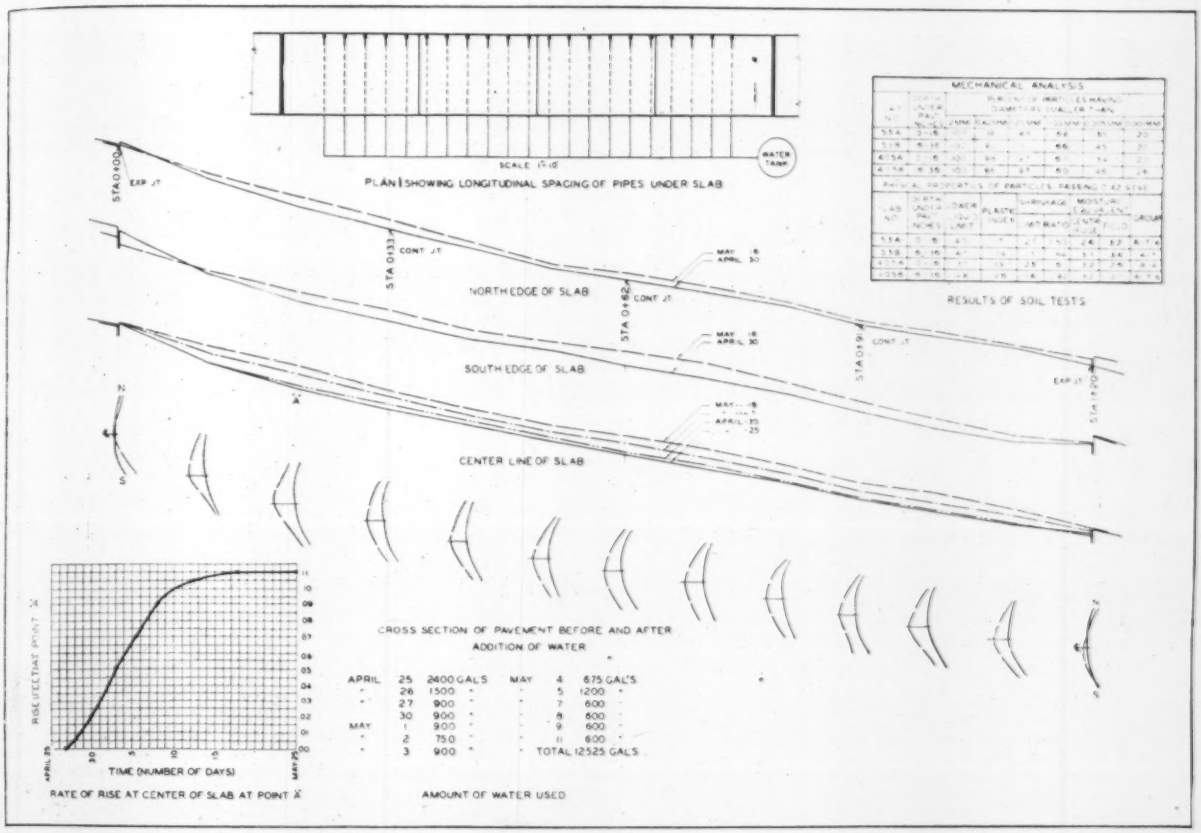

PLAN SHOWING LONGITUDINAL SPACING OF PIPES UNDER SLAB
MECHANICAL ANALYSIS
RESULTS OF SOIL TESTS
NORTH EDGE OF SLAB
SOUTH EDGE OF SLAB
CENTER LINE OF SLAB
CROSS SECTION OF PAVEMENT BEFORE AND AFTER ADDITION OF WATER
RISE AT CTAT POINT A
TIME (NUMBER OF DAYS)
RATE OF RISE AT CENTER OF SLAB AT POINT A
AMOUNT OF WATER USED
APRIL 25 2400 GALS
" 26 1500 "
" 27 900 "
" 30 900 "
MAY 1 900 "
" 2 750 "
" 3 900 "
MAY 4 675 GALS
" 5 1200 "
" 7 600 "
" 8 600 "
" 9 600 "
" 11 600 "
TOTAL 12525 GALS

FIG. 2—TESTS RESULTS obtained in correcting distortion of concrete pavement by injecting water into subgrade.

moved was tamped back but was too dry to be brought to a dense state of compaction. In the slab now being lifted the pipes were driven directly through the shoulders and under the pavement without the aid of trenches.

Water was admitted to the subgrade during about eight hours each day. The quantities of water introduced are shown in the lower part of Fig. 2.

The rise of the pavement at various periods resulting from the introduction of water into subgrade is shown graphically by the profiles and crown elevations in Fig. 2. It will be noted that the uplift of the slab caused by the water restored the original crown and contour of the slab. It was found that the vertical uplift was proportional to the moisture content of the soil before water was introduced, being greatest where the original moisture content was least. These results substantiate the fact that the distortions were caused by unequal moisture distribution and were not surprising, as this was strongly indicated by previous studies in the field and in the laboratory. Even the rate of rise of the slab at various points closely approached the results of the time-volume change tests conducted in the laboratory. A time-rise curve from point *A* at the center of the slab is shown in Fig. 2.

It will be seen from Fig. 2 that there was some difference in the total rise along the north edge of the pavement as compared to that along the south edge. This was due to the difference between the original moisture content of the soil under the north edge compared to that under the south edge. The difference in moisture content between the two sides may be attributed to the water from snow which had drifted on the north side (whereas none had drifted on the south side), and also to the fact that the sun and prevailing hot winds from the south had caused more evaporation on that side than on the north. The greater moisture content on the north had therefore caused a greater original volume change than that caused by the lower moisture content on the south.

It will be seen from the accompanying table that there was a definite moisture gradient in the subgrade soil approaching the joint, both in the 0- to 18-in. and the 18- to 36-in. depths under the pavement before water was introduced into the subgrade. The study of densities of the soil showed a voids ratio of 0.97 for the 0- to 18-in. depth at a distance of 1 ft. from the joint; 0.93 at a distance of 5 ft. from the joint and 0.88 at a distance of 15 ft. from the joint. The values for voids ratio of the soil for the 18- to 36-in. depth showed values of 1.03, 0.88 and 0.81 respectively for the distances mentioned above. The table also shows that the addition of moisture to the subgrade destroyed the moisture gradient approaching the joint.

It was found that the subgrade absorbed water according to its capacity —that is, in quantities proportionate to

MOISTURE CONTENT OF SUBGRADE SOIL BEFORE AND AFTER ADDITION OF WATER
(Per Cent of Dry Weight)
All test holes made 4 Ft. right of Center Line

	Depth Under Pavement, In.	Station 0+17	0+47	0+70	0+90	1+05	1+15	1+19
Original Moisture Content	0–18	15.7	15.3	13.1	13.9	13.4	22.6	28.1
	18–36	16.8	20.4	14.4	17.9	17.3	19.0	25.3
Final Moisture Content	0–18	24.4	20.7	25.5	24.1	21.5	21.5	25.5
	18–36	23.2	22.6	25.9	23.2	20.8	22.9	25.6

ORIGINAL MOISTURE CONTENT IMMEDIATELY UNDER PAVEMENT AT VARIOUS DISTANCES IN FROM THE EDGE (STATION 0+50)

Distance from Edge, Ft.	1	2	3	4	5
Moisture Content	18.1	19.1	18.6	19.6	12.4

the voids ratio at the various points indicated. It will be noted that after the addition of water to the subgrade no decided trend in increasing moisture content approaching the joint was observed. After the addition of water, the voids ratio of the soil was uniform for a given depth at the various locations mentioned. However, a close observation of the moisture contents after the introduction of water (see table) and the profile of May 18 (Fig. 2) indicates that possibly the experiment was stopped before the subgrade had completely satisfied its ability to absorb water.

It was found in investigating the moisture content of the subgrade that the moisture that had entered along the edge had progressed under the slab to a distance of between 4 and 5 ft. This was true on both the north and south sides. The values shown in the lower part of the table indicate the sharp break in the moisture content at that point. The water entering along the edges had caused not only a partial loss of crown but had also jacked the pavement so that there was some lack of support near the center line of the slab. After the application of water this difference in moisture content was destroyed, causing a greater rise at the center and resulting in the return of the original crown, as shown in Fig. 2. In some places the resulting crown was greater than its original value.

The change in appearance of the cracks was of particular interest. The old cracks appeared to open somewhat across the area of greatest moisture increase. It is also of interest that only one new crack appeared on the surface of the slab. This new crack occurred in the south half of the slab at station 1+05. Although it was not observed, in a very close study made before the application of water to the subgrade, it is quite probable from observations made on other slabs on this project that the crack existed in the bottom part of the slab previous to lifting the pavement.

Detailed costs were kept of the materials used, the labor required and the amount of transportation necessary to consummate the work. The costs of this project were divided as follows: materials $159.93; labor and supervision $98.95; transportation $44.14. These costs are necessarily considerably higher on this experiment than they would be if this work were made a routine maintenance practice.

At the present time a second slab is being lifted. On the second slab a horizontal spacing of 10 ft. is used between the pipes under the pavement. It is desirable to see if the rate of rise of the slab is comparative with that of the first slab where the pipes were placed 5 ft. apart. The original pipes and fittings were used, indicating that the material has almost 100 per cent salvage value from time to time. It is estimated that if this method of straightening the pavement were adopted as a routine maintenance project, it could be accomplished at a cost of approximately 45c. per square yard.

Levels are being taken on this experimental section at intervals of two weeks to study the permanence of this form of lifting warped slabs. As the work progresses, it is planned to use different materials on the shoulders to prevent the loss of subgrade moisture by evaporation from the shoulders in an attempt to determine the type of material most effective in retaining the subgrade moisture content.

Sewage-Plant Survey—VIII

Data from Baltimore, Md.

THE FOLLOWING ARTICLE is the eighth of a series presenting in brief form the salient design and performance characteristics of American sewage plants. Articles already published have presented data from the following cities: Decatur, Ill., Cleveland, Ohio, Schenectady, N. Y., Aurora, Ill., Lima, Ohio, Grand Rapids, Mich., and Urbana, Ill.

SEWAGE TREATMENT at the Back River plant of Baltimore, Md., achieved an 87 per cent reduction in B.O.D. as an average for the year 1933. Treatment units employed are primary sedimentation tanks, trickling filters and secondary settling tanks. Sludge is digested in separate digestion tanks and dried on sand beds. Detailed design and performance data for 1933 are given in the accompanying tabulation.

The sewerage system of Baltimore is of the separate type. The design of the original treatment-plant installation was made by the engineers of the old Baltimore Sewerage Commission between 1906 and 1911. Numerous additions have been made since the plant was put into operation in 1911, especially in the periods from 1911 to 1916 and from 1921 to date. Total cost of the plant to date is estimated at $5,200,000. The plant is now operated by the bureau of sewers, with G. K. Armeling in charge as superintendent. C. E. Keefer is engineer of sewage disposal.

In the following table, figures given are the average for the year. Flows reported were measured by venturi meters. Analytical data were derived from tests on composite samples, except in the case of B.O.D. tests, which were made on catch samples.

SEWAGE-PLANT PERFORMANCE DATA, BALTIMORE, MD.

GENERAL DATA

Population, 1933	827,000
Population served, 1933	755,000
Sewage flow	
Average, m.g.d.	76.4
Maximum day, m.g.d.	161.6

SEWAGE-TREATMENT UNITS

Coarse Screens	
Number of units	2
Width of opening, in.	1
Submerged area of screen, vertical projection, sq.ft.	480
Angle of screen with horizontal, deg.	75
Method of cleaning	manual
Primary Sedimentation Tanks	
Number of units	4
Plan dimensions, each unit, ft.	420x103
Operating depth, including sludge space, ft.	12½
Depth allotted to sludge space, ft. (hopper bottom)	2
Provisions for sludge removal	centrifugal pumps
Frequency of sludge removal	daily
Sewage flow, all units, m.g.d.	76.4
Detention period at actual flow, hr.	3.5
Trickling Filters	
Number of units	10
Plan dimensions, each unit, ft.	350x390
Sewage flow, all units, m.g.d.	90
Type of filter material	trap rock
Depth of filter material, ft.	8½
Type of distributing system	spray nozzle
Type of underdrain system	tile gutter
Secondary Sedimentation Tanks	
Number of units	2
Plan dimensions, each unit, diam. in ft.	291x277
Operating depth, including sludge space, ft.	10½
Depth allotted to sludge space, ft. (hopper bottom)	2
Provisions for sludge removal	centrifugal pumps
Sewage flow, all units, m.g.d.	76.4
Detention period at actual flow, all units, hr.	3.5

SLUDGE DISPOSAL

Sludge Digestion Tanks	
Rectangular units	
Number of units	10
Plan dimensions, each unit, in ft.	114x91
Depth, each unit, ft.	13½
Capacity, each unit, cu.ft.	190,000
Circular units	
Number of units	35
Plan dimensions, each unit, diam. in ft.	40
Depth, each unit, ft.	24
Capacity, each unit, cu.ft.	20,000
Sludge-Drying Beds	
Number of units	12
Total area, acres	13
Depth of sand, in.	4
Depth of sludge applied, in.	12

ANALYTICAL RESULTS

	Settleable Solids (2 hr.) p.p.m.	Suspended Solids p.p.m.	Five-day B.O.D., p.p.m.
Raw sewage	121	175	249
Primary-tank effluent	22.1	49.9	99
Trickling-filter effluent	18	28.6	30
Secondary-tank effluent	17.6	27.1	33

SCREENINGS, GRIT AND SLUDGE

	Volume, Cu.Ft. Per M.G.	Dry Solids Per Cent	Volatile Solids Per Cent	pH	Disposal
Coarse screenings	1.3	....	....	....	Sold to farmers
Primary-tank sludge[1]	229.5	5.5	74.9	....	To digestion tanks
Secondary-tank sludge[1]	2.8	3.0	....	....	To digestion tanks
Digested sludge[1]	96.0	5.9	58.0	6.9	To drying beds
Dried sludge	25.5	45.0	....	....	To farmers, parks

[1] On 90 per cent moisture basis.

Long Concrete-Arch Viaduct Built Near Cleveland

Structure on Brookpark Road in metropolitan park area distinguished by special architectural treatment, cooling of mass concrete in piers and use of railing expansion joints of rubber

By W. H. Rabe and D. H. Overman
Chief Designing Engineer and Designing Engineer, Bureau of Bridges, Ohio Department of Highways, Columbus, Ohio

THE MOST RECENT and largest of three open-spandrel arch bridges to be constructed in the Cleveland metropolitan area by the Ohio department of highways is a structure known as the Brookpark Viaduct, located on an extension of Brookpark Road, state route 43, immediately southwest of the city limits of Cleveland. It provides a new high-level crossing of the Rocky River Valley and completes another link in a proposed belt highway around the business section of Cleveland. It is situated just west of the Cleveland Airport, and, with its approaches, was built as a federal-aid project with financial participation by Cuyahoga County.

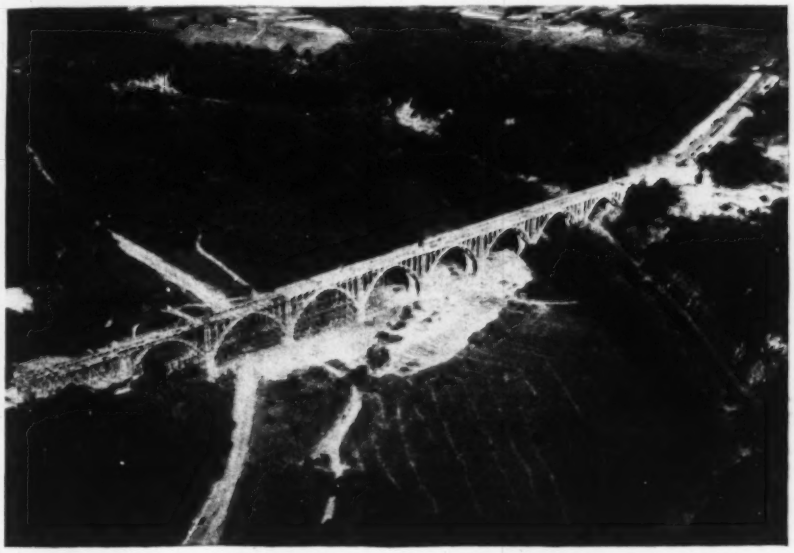


FIG. 1—BROOKPARK VIADUCT in Cleveland's metropolitan park area provides a high-level crossing of the Rocky River Valley.

Although the normal channel of Rocky River is relatively narrow, its valley, like that of other streams that flow into Lake Erie in this section, is very wide and deep, practically making a high-level structure necessary in the interest of economy and to provide appropriate highway gradient. The entire river valley at this location is a part of the metropolitan park system.

The open-spandrel concrete-arch type was selected as fulfilling the requirements of pleasing appearance and economy. As it was to be the third viaduct of this type built in Cuyahoga County by the state highway department, it was considered desirable for the sake of variety to develop a somewhat different style of architecture than had previously been used. The result is a bridge embodying a Gothic motif as shown in some of the accompanying views.

Springing from the steep shale bank on the east side of the valley, the arch spans cross the river and park to the gentle slope on the west side. This arch portion, of open-spandrel deck construction, consists of eight spans, the two end spans being unsymmetrical, to fit the topography, measuring 176 ft. 10½ in. c. to c. of piers, and the other six symmetrical arches being of 192-ft. 3-in. span c. to c. of piers. Beyond the arches, up the west slope, are six 33-ft. concrete T-beam spans, of continuous type, with the underneath side of the beams arched. East of the arches are three T-beam spans similar to those at the west end, except that the middle one, which spans a small ravine, is 50 ft. long. A U-shaped abutment is provided at each end. The over-all length is 1,918 ft. 7 in., and the greatest height from ground line to road surface is 116 ft.

All piers and abutments are founded on hard shale, some of which is exposed and some as deep as 20 ft. below the ground surface.

The loading used in design was H-20. The maximum unit stress for concrete was 900 lb. per sq.in. in bending, and the maximum tensile stress for reinforcing steel 16,000 lb. per sq.in.

The roadway, 40 ft. wide, is paved with 3-in. brick on a ¾-in. slag cushion, and there are two 5-ft. sidewalks raised 12 in. above the brick pavement. The rather high curbs have decided safety advantages on such a high structure in this region, where deep snow tends to fill the gutters. All drainage water is carried in downspouts to a storm sewer that parallels the bridge. The road ascends from east to west on a 0.3 per cent gradient.

The lighting standards and luminaires are of cast aluminum, deplated and highlighted, which provides both handsome appearance and assurance of freedom from soiling of the supporting concrete members due to corrosion. A balcony at each pylon (situated between the arch portion and the approach spans of the structure), besides adding a touch of ornamentation, affords the sightseer an opportunity for enjoying a view of the side of the bridge as well as the park below. Particular attention was given to the treatment of the arch umbrellas, in order to obtain a pleasing transition from the slender columns to the massive pier pedestals. A projection on the face of the ribs along the extrados was added to enhance appearance.

Crack prevention in piers

On several previously built arch viaducts, shrinkage cracks developed in the piers below the umbrellas. On the assumption that such cracks result from the heat generated in the mass concrete, five 24-in. vertical pipes were installed in each pier on the Brookpark Viaduct, to permit the free circulation of air during the curing of the concrete (Fig. 3). The tops of these pipes were later sealed by the umbrella sections, but horizontal vents, placed from the pipe to the surface of the concrete, remained open. So far no cracks are visible.

Rib and deck design

Each arch span is supported by two ribs 7 ft. wide with a thickness of 3 ft. at the crown and 5½ ft. at the skewbacks. Each rib has a rise of 80 ft. 2½ in. It was found possible to make a major portion of each unsymmetrical end arch identical with the symmetrical arches, thereby facilitating construction and adding to the appearance of the structure.

The deck is a continuous slab, crowned on top and bottom and placed mono-

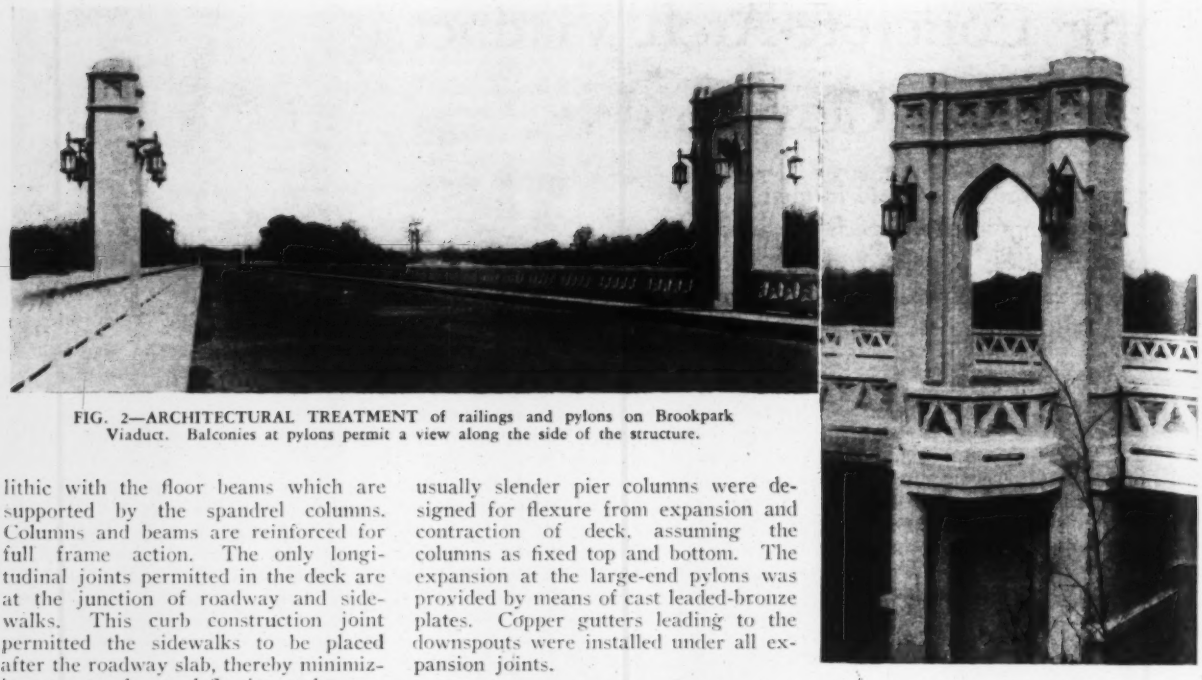


FIG. 2—ARCHITECTURAL TREATMENT of railings and pylons on Brookpark Viaduct. Balconies at pylons permit a view along the side of the structure.

lithic with the floor beams which are supported by the spandrel columns. Columns and beams are reinforced for full frame action. The only longitudinal joints permitted in the deck are at the junction of roadway and sidewalks. This curb construction joint permitted the sidewalks to be placed after the roadway slab, thereby minimizing stresses due to deflection and transverse shrinkage. In addition, such joints permit a true alignment of curb forms, since they may be rigidly supported upon the finished roadway slab.

The practice of omitting expansion joints in the arch deck, except at piers, was followed on this structure because there is always the risk of water leakage and concrete deterioration at a joint and because tests conducted by the designers on paper and celluloid models of previously designed structures indicated that intermediate joints are unnecessary. The spandrel columns and the unusually slender pier columns were designed for flexure from expansion and contraction of deck, assuming the columns as fixed top and bottom. The expansion at the large-end pylons was provided by means of cast leaded-bronze plates. Copper gutters leading to the downspouts were installed under all expansion joints.

Rubber railing joints

Expansion joints were also provided between all railing panels and posts, the posts and panels being anchored independently to the deck. At piers and abutments where there are expansion joints in the floor system, the joints in the railing were left open with a 2-in. space. All intermediate panels and posts were separated with a sheet of light-gray sponge rubber ½ in. thick. This material proved to be very satisfactory both in ease of handling and in finished appearance, as it is quite pliable, does not extrude when compressed and matches substantially the color of the concrete.

The rubber was cemented to the ends of the finished concrete panels, which were placed first, and the post concrete was then deposited in direct contact with the rubber. Open joints between railing panels and posts require more difficult form building and, as the joints

FIG. 3—STRUCTURAL DETAILS and sections of open-spandrel arches and T-beam spans comprising the new Brookpark Viaduct near Cleveland.

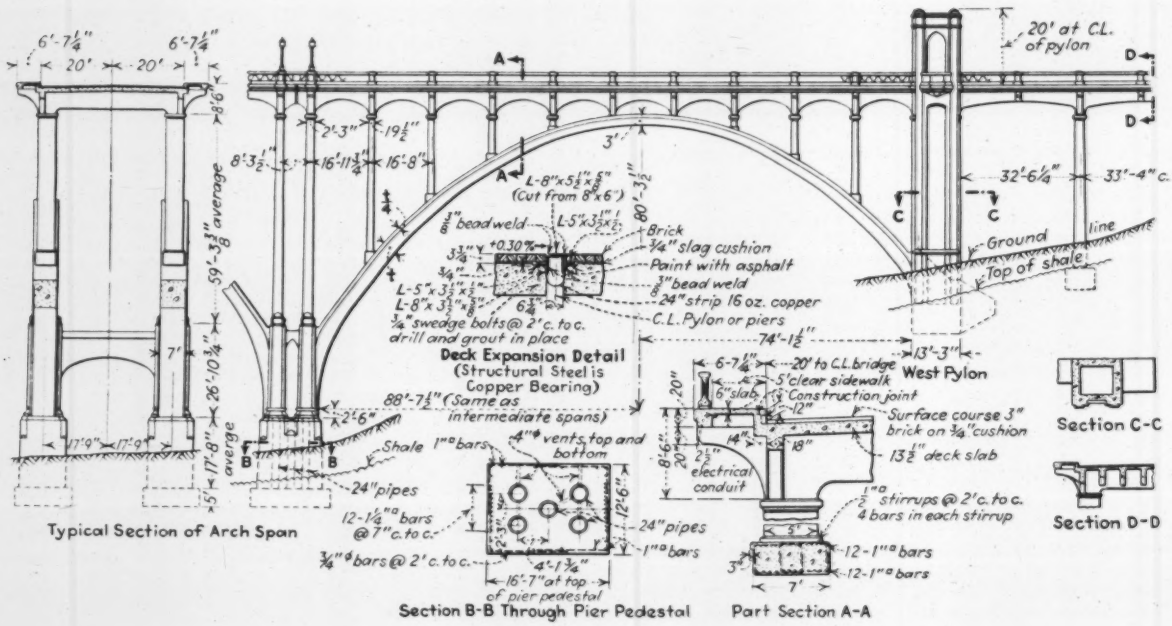


FIG. 4—SPONGE-RUBBER expansion joint being cemented to railing, ready for post to be concreted in.

must necessarily have an opening of ½ in. or more, they are more conspicuous in appearance. If the life of the rubber proves to be relatively short, it will merely result in open joints of smaller size and better appearance than the preformed open type.

In constructing the viaduct a concrete mixing plant was set up in a small ravine on the east bank and operated as a gravity unit with a three-level arrangement. The bins for the slag, sand and cement were on the upper level and were filled by trucks. The proportioning of aggregates was controlled by weighing devices below the bins; and, by means of a chute under these batch weighers, the aggregates were conducted into the mixer, 1 cu.yd. of concrete being mixed at one time. The plant had a capacity of 30 to 35 cu.yd. of concrete per hour and included a 250-hp. boiler to steam-heat materials during winter operations.

The contractor used timber falsework throughout, both to support the forms and to carry an industrial railway by means of which the concrete was transported from the mixing plant to various portions of the structure. The industrial tracks were laid at three levels. From the lower level the pier masses and footings were placed, from the intermediate level the arch rings and columns, and from the upper level the deck concrete. Precast concrete blocks, concreted in the deck, supported the railway on the deck.

Metal forms were used for the piers and arch columns, and a combination wood and metal form was used for the umbrellas. Elsewhere the forms were of wood. Three-ply wood lining was used for surfaces that were to be exposed, with the result that a pleasing texture was obtained with a minimum of rubbing.

The railing, although distinctly ornamental, involved simple form construction and, because of the extensive repetition of identical panels, its cost was rather low.

Cost and personnel

The contract price for the bridge was $378,980, which amounts to only $3.72 per sq.ft. of total deck area. The bridge was built by the Highway Construction Co., Cleveland, whose contract also included 0.657 miles of brick paving on the approaches, with considerable grading, at a price of $65,982.

The work was done under the direction of O. W. Merrell, director of highways; H. P. Chapman, assistant director; J. R. Burkey, chief engineer of bridges; and Elmer Hilty, chief engineer of construction. The design work was supervised by the writers with Mr. Overman in immediate active charge, assisted chiefly by C. P. Smith and A. J. Frienoth. Richard Orth was field engineer, and John Jaster, Jr., division engineer.

Two Public Power Projects Get Under Way in Nebraska

Financed by the PWA, work on the Loup River power project and on the Sutherland combined power and irrigation water-supply project has reached the stage where detailed plans are being made and some construction contracts have been let

AMONG the large allotments of funds made by the Public Works Administration are two totaling nearly $15,000,000 for public power and irrigation projects in Nebraska. One loan is to the Loup River Public Power District at Columbia for a power-development scheme, and the other is to the Platte Valley Public Power and Irrigation District for a combined project for the storage of water for irrigation use and for the development of power near North Platte. Both projects are being constructed under a law passed by the state legislature in 1933, a law that authorizes the creation of public power and irrigation districts managed by directors elected by popular vote and paid at a basis "not exceeding $6 per day." The districts are permitted to build and own irrigation and power works, to store and sell water and to generate and sell power. They have no powers of taxation but may pledge their revenues and physical property as security for loans from federal agencies. The districts may engage in any enterprise incident to the electric business. All profits are to go to water users and electric consumers.

The original estimates of the cost of the Loup River project were $5,734,000, and the approved PWA loan is for $7,300,000; the original estimate of the Sutherland project was $4,806,000, and the PWA has approved a loan up to $7,500,000. Applications for the loans were made, and the loans were granted upon the preliminary estimates. Work now is in progress on the detailed surveys, test borings and estimates. A considerable amount of land has been purchased, and contracts have been let for some of the work.

In both instances the preliminary estimates were prepared by local engineers, but on both projects outside engineering firms experienced in hydroelectric power-development work have been engaged to direct the design and construction work, the engineers who made the original estimates also being retained. In so far as is practical, the employment of engineers from Nebraska is required.

An outline of the work proposed and a review of the special conditions affecting each project are given below.

Loup River Project

THE LOCATION and general arrangement of the project of the Loup River Public Power District are shown in Fig. 1. It consists of a diversion dam on the Loup River about 9 miles southwest of Genoa and a system of canals to divert, normally, 2,500 sec.-ft. of water, first to a power house about 1 mile north of Monroe and thence to a power house 2½ miles north of Columbus, whence the water is delivered to the Platte River 3 miles below the mouth of the Loup River. Storage and regulating reservoirs along the line of the canal are included, but whether all will be built at the present time has not been decided definitely. The project is entirely for the development of power.

The Loup River Public Power District proposes to develop 240,000,000 kw.-hr. of electricity per year—of which 140,000,000 kw.-hr. is firm power—and supply it to an area in eastern Nebraska and western Iowa within a radius of 100 miles to the south, east and north of Columbus and 48 miles to the west. Lincoln, Omaha, Council Bluffs and Sioux City are the large cities in the territory that it is proposed to serve. The total present consumption is 641,000,000 kw.-hr.

The Loup River system has its origin in the lakes and marshes of the sandhill regions of the north central and west portions of Nebraska. Its length is 280 miles, and the fall is from El. 3,900 to El. 1,410 ft. at the river's mouth. Thus the average slope is 7½ ft. per mile. The drainage area is 15,000 sq. miles, and the mean annual rainfall varies from 12 to 20 in. at the headwaters to 28 in. at the mouth. During the dry periods of the year underground storage maintains a relatively uniform flow.

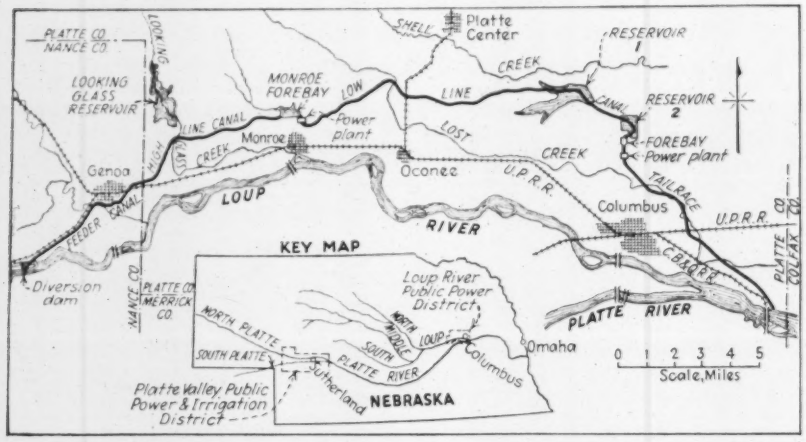


FIG. 1—THE LOUP RIVER PROJECT calls for the construction of 35 miles of canals, four reservoirs and two power plants. Water is diverted from the Loup River above Genoa and returned to the Platte River below Columbus. The key map shows the location of the Loup and Sutherland projects.

Water of the Loup River is used principally for domestic purposes, with only a small amount used for irrigation in the upper stretches. The upper and drier areas are not suited to irrigation and the lower basin does not need irrigation.

Gagings at Columbus date back to 1895. The mean monthly discharge is 3,210 sec.-ft. at Columbus, or 3,000 sec.-ft. at Genoa. The flow exceeds 2,500 sec.-ft. for 70 per cent of the time, the maximum being 30,000 and the minimum 600 sec.-ft. The former is due to melting snow and ice in the spring; the latter occurs when the river first freezes in the winter and lasts only one or two days. The low stage of appreciable duration, one to five months, comes in late summer.

The diversion canal is to have a 680-ft. concrete spillway crest capable of passing 30,000 sec.-ft. at a 4-ft. depth. The 50-ft. downstream apron is to be protected at the lower edge by 28-ft. wakefield sheetpiling, and the cutoff wall at the upstream face of the dam is to be 30-ft. steel piling driven through the fine flowing sand and 3 ft. into the underlying bed of Niobrara chalk rock. This will give a percolation path of 136 ft., to sustain the hydrostatic head of 13 ft. when the crest is under maximum flood stage.

Diversion of sand into the canal is to be prevented through the use of sluiceway gates with sills 5 ft. below the sills of the diversion gates. Special attention is being paid to silt elimination.

Fine loess and sand that will be carried in suspension in the first water admitted to the canals will be depended on to seal the voids in the sand in the canal bottom and banks. Enlarged sections in the more porous divisions will reduce the velocity, thus encouraging sedimentation. Minimum freeboard is 5 ft. for 2,500-sec.-ft. flow and 3 ft. for 3,200-sec.-ft. flow. The latter will increase the velocity to 2.8 ft. per second.

Canal system

The canal system has four divisions: the diversion canal, the high line, low line and tailrace. The diversion canal is a 3.6-mile section to Beaver Creek, designed to accommodate the shallow depth of water back of the diversion dam. The water depth will be 12.2 ft. at 2,500-sec.-ft. flow. The base width is to be 60.5 ft. and slopes 1.5 to 1 in firm soil but 2 to 1 in others.

The high-line canal begins at Beaver Creek and extends 8.4 miles to the Monroe Reservoir. Maximum hydraulic efficiency is expected from this canal. It has a base width of 45 ft. and a 14.4-ft. depth at 2,500-sec.-ft. flow. Generally a slope of 0.00008 will be maintained. A 2.6-ft. velocity is considered maximum.

The 14.75-mile, low-line canal will receive the tailwater from the Monroe station and discharge into the penstock lines of the power station north of Columbus. In cross-section it will be similar to the high-line canal.

It is expected that from 4 to 5 miles of the canals will be in sandy soil of such character requiring a lining. Seepage losses in the sand sections are estimated at 0.7 per cent per mile and in the loess and clay soils at 0.3 per cent per mile. The total loss is figured at less than 10 per cent for the total mileage of canals.

Surface runoff above the canals is to be collected in surface drainage ditches and carried to concrete siphons under the canal. Operating emergencies requiring disposal of canal water will be met by discharge through waste sluices at the control works of the reservoirs. Water that has passed the control works below the Monroe station will be retained in the canal and regulating reservoirs between Monroe and the Columbus power station and will be released through a 60-in. bypass valve at the latter station.

Both the higher velocities to be employed in the tailrace canal and the possibilities for economy in construction were determining factors in the design of that channel. The base is 21 ft. wide, and depth is 16.6 ft. when carrying 2,500 sec.-ft. at 4 ft. per second. This section holds to within 2.5 miles of the outlet, where the depth is reduced to 10 ft. and the width increased to 52.5 ft. by an 8-ft. concrete drop. This change is necessary to avoid interference with surface drainage and to permit entering the Platte River without a sharp change in the depth of water.

Regulating reservoirs

Three reservoirs are contemplated for inclusion in the present program: a storage reservoir on Looking Glass Creek and two regulating reservoirs just above the lower power plant. The first will have a capacity of 9,000 acre-ft., or a little more than 10 per cent of a mean annual runoff of 25 in. from the 40,000 acres of drainage area above it. It will have a surface area of 623 acres from which, in summer, evaporation is estimated at 13 acre-ft. per day, about half the minimum flow of the creek.

An earth dam, 2,075 ft. long, with a puddled core and an upstream face paved with concrete will form the Looking Glass Reservoir. Its discharge works will handle 2,500 sec.ft. when under 20-ft. head, at which time the reservoir will be one-fourth full.

Regulating reservoir No. 1, within 2.75 miles of the penstocks of the lower power house, is to be formed by construction of a low earth dam 4,075 ft. long, of which not over 900 ft. will have to sustain a depth in excess of 9 ft. Only 60 per cent of the 4,000-acre-ft. capacity will be available for regulation.

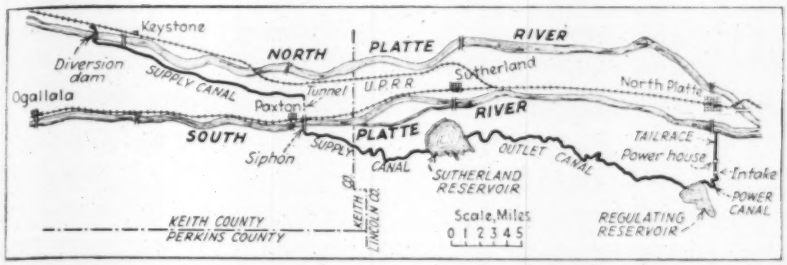


FIG. 2—THE SUTHERLAND PROJECT calls for diversion of water from the North Platte River through a canal, tunnel and siphon to a storage reservoir on the far side of the South Platte. As required for irrigation, the water is returned to the river through a power plant.

The proposed smaller regulating reservoir (No. 2) will be less than one-half mile from the penstocks and will have a capacity of 1,700 acre-ft., of which 70 per cent is available. It will be surrounded entirely by low dikes.

Since the total power production for the minimum year is equal to one-third of the present consumption within the territory to be served, it is hoped that the total possible production can be utilized. Other reservoir storage in the upper Loup River system is not now contemplated, deficiencies being made up by existing steam plants in Omaha, Fremont and Lincoln. When these plants become obsolete, further available storage sites will be studied.

Power plants

At the Monroe plant the penstock and power house will be built integral with a small earth dam 3,000 ft. long, forming a forebay of 900-acre-ft. capacity. The plant will house two 4,500-hp. hydraulic turbines, operating under a head of 26 ft., and two 3,750-kva. vertical generators.

The Columbus station will have concrete headworks at a small forebay on top of a hill, from which three 900-ft. lengths of 14½-ft. welded pipe will supply three 16,500-hp. waterwheels operating 14,000-kva. vertical generators under a 100-ft. head. A transmission line of 33,000-volt capacity will connect the two plants, and a 66,000-volt line will connect the Columbus station with the existing 66,000-volt line from Columbus to Central City. A new 66,000-volt line, 60 miles long, will be built to connect with the Nebraska Power Co. line at Waterloo, also a 66,000-volt line, 63 miles long, to Lincoln. At Lincoln this line will join a 66,000-volt line to Omaha, where general distribution over existing lines can be obtained in Iowa.

It was estimated that an average of 975 men will be employed for two years, ranging from 200 to 1,500. When completed, it is estimated that only 50 to 75 men will be employed regularly.

Personnel—The board of directors of the Loup River Public Power District has employed the Harza Engineering Co., Chicago, to head up the engineering organization. Eric Floor is resident engineer in charge for the Harza Engineering Co., with L. F. Harza, president, on the job much of the time. Fred Albert, of Columbus, Neb., who made the preliminary report, is supervising engineer of field work. Some half-dozen engineers from the Chicago office of the Harza Co. have been transferred to Columbus, including C. H. James, Henry Miller, C. E. Wattles, H. A. Beckwith and F. E. Peacock. The remainder of the staff has been recruited from Nebraska.

Sutherland Project

COMBINING storage of water for irrigation with hydro-electric power development, the Sutherland project of the Platte Valley Public Power and Irrigation District proposes to store 146,000 acre-ft. of water from the North Platte River in the Sutherland Reservoir, and feed it back into the South Platte River through a 34,000-hp. power plant immediately south of the city of North Platte. This water will then be used on eight existing irrigation districts between North Platte and Kearney, mainly between Gothenburg and Kearney, a distance of 60 miles. The districts have already signed contracts totaling 100,000 acre-ft. of water annually, which will provide the 176,000 irrigated acres of the eight districts with sufficient additional water to assure valuable late-season July and August irrigation. The proposed Sutherland storage will supply a continuous flow of 1,000 sec.-ft. when the crops need it most.

Available water

The mean annual discharge of the North Platte at Keystone over a period of 35 years has been 2,000,000 acre-ft., equivalent to 2,740 sec.-ft. Existing canals between Keystone and North Platte, where the water will be returned to the river, require 480 sec.-ft. during the irrigation season. The Sutherland project requires 1,000 sec.-ft. during a two-month period in the irrigation season and 800 sec.-ft. for the rest of the year. Storage of excess flow from Sept. 15 to the following May 15 is essential to make up the uncertain flow from May 15 to Sept. 15. Records for 21 years indicate that the 140,000 acre-ft. required to fill Sutherland Reservoir would have been obtained every year. Also the natural flow supplemented by this stored water would have supplied all requirements for irrigation and power except for a period of 20 days in 1931. (The report from which this information was taken was written in 1932 so that the drought effects of this year are not included.)

The project includes a diversion dam with control gates, 48 miles west of North Platte, a 19-mile canal along the south bank of the North Platte, a 2,800-ft. tunnel under the divide between the North and South Platte Rivers, a 13-ft. inverted siphon across the South Platte, a 14-mile canal to the 140,000-acre-ft. Sutherland storage reservoir, a 25-mile outlet canal to a 6,000-acre-ft. regulating reservoir, a short power canal to steel penstocks leading to the power house, 4 miles south of North Platte. A tailrace will carry the water back to the South Platte River just above its confluence with the North Platte River east of the city of North Platte. The existing irrigation canals that will use this water all have their headgates on the river below North Platte.

Headworks and canals

The headworks at the diversion dam, which is 2 miles west of Keystone, will consist of a 1,200-ft. ogee section concrete spillway with the necessary control gates of the radial and overshot weir type. A flood of 38,000-sec-ft., 40 per cent greater than the largest of record, is the capacity provided.

The eight 20x3-ft. weir gates into the canal will pass 1,300 sec.-ft., the capacity of the canal. Four radial gates 20x10 ft. are provided to pass the silt settling back of the overflow dam downstream. Details are still under discussion, particularly those relating to silt disposition. On the 33 miles of supply canal, which has a typical cross-section with 33-ft. bottom width, 11- to 13-ft. water depth and 1½ to 1 side slopes, some 2 miles will probably need lining. In the lined section the bottom width will be restricted to 16 ft. The canal is generally side-hill embankment and cuts of the U. S. Reclamation Bureau standard design. At either end of the 2,800-ft. tunnel a 2,500-ft. approach section will be lined. The tunnel under the divide between the two branches of the river is to have a 12x14-ft. horseshoe section. This is in loess and will be lined. A ledge of limestone rock may be encountered. Borings are not yet completed. It is possible that this work may be in open cut, as the cover is only 116 ft. and usually loess formations stand up remarkably well.

Canals, generally, are laid out on the basis of a velocity of 2.75 ft. per second

with n in Kutters formula assumed at 0.0225 for unlined section and 0.014 for lined sections. This gives a fall of 18 ft. from low lake level (down 50 ft.) in the long 25-mile outlet canal.

The siphon across the South Platte Valley and over the flowing river will be 7,500 ft. long. This will be of monolithic reinforced concrete under the railroad and highway and of steel welded pipe, 13 ft. in diameter, over the river channel. As now planned, foundation piers of concrete in the bed of the river will support the pipe at 30- to 40-ft. intervals by means of rings of I-beam section framed at the sides into supporting columns resting on individual piers, thus following European practice, as elaborated on recently by the U. S. Reclamation Bureau. The maximum hydraulic head will be about 60 ft.

Storage reservoir

Below the siphon is another section of the canal of 1,300-sec.-ft. capacity, 14 miles long, leading to the Sutherland Reservoir, which is to be formed in a natural depression in the tablelands 3 miles south of Sutherland. The maximum depth will be 75 ft.

The rolled-earth dam and dike forming the reservoir will be 29,000 ft. long and will involve moving into place 1,500,000 cu.yd. of earth. The outlet will provide for a drawdown of 50 ft., so as to permit that much usable storage. The drop-outlet structure will have provision for energy dissipation in the steel-lined concrete conduit prior to entrance into the outlet canal leading to the regulating reservoir. The 25-mile outlet canal ordinarily will carry 800 to 900 sec.-ft. but will have a section capable of carrying a maximum of 1,400 sec.-ft.

Power plant

The 34,000-acre-ft. regulating reservoir, of which 6,000 acre-ft. is available, will discharge through regulating works into a 2½- to 3-mile length of unlined power canal having an 1,800-sec.-ft. capacity and ending in a small forebay discharging into steel penstocks dropping 200 ft. to the two 17,000-hp. turbine units. A spare turbine may be included. As located tentatively, the tailrace cut at the power house will be 50 ft. deep.

The operation contemplates use of the large reservoir as a supplement to the available streamflow for firm power production throughout the year, and during the irrigation season the outflow from the power plant will also be used for irrigation.

Electricity will be delivered over 200 miles of transmission lines at 66,000 volts. The market territory is the Platte Valley east to Grand Island and the area south of the valley between McCook and Hastings.

In this territory, which had a population of 129,000 in 1930, are four distributing companies and several municipalities. Of the total 82,000,000 kw.-hr. per year used, 66,000,000 kw.-hr. are now generated by steam and oil, the remainder by water power. It is the 66,000,000 requirement that is considered the market for the new power. Since it was considered that the supplemental irrigation water will greatly increase the population between North Platte and Grand Island, with resultant growth in electrical requirements, the excess of production over present needs is held to serve this additional prospective growth.

The district's collateral with PWA is secured by the contracts at $1 per acre-foot for the sale of 100,000 acre-ft. of stored water for irrigation in any season. As soon as the power contracts are signed, they also are to be entered as additional PWA collateral.

Personnel—Parsons, Klapp, Brinckerhoff and Douglas, of New York, represented by John P. Hogan, are consulting and designing engineers for the project. Eugene E. Halmos represents the firm locally and is assisted by S. A. Thoresen as principal designing engineer, H. Alden Foster as hydraulic and structural engineer, and Rudolph Dueland as electrical engineer. Donald D. Price who made the initial studies is chief engineer and general manager of the project. He is assisted by C. J. McNamara, hydraulic engineer, Robert Fulton, electrical engineer, and Charles M. Coff, chief office engineer. The district furnishes personnel for surveys, design, drafting, inspection and business office, which includes legal matters and real estate.

A contract for the construction of the Sutherland Reservoir has been let to C. F. Lytle and the Western Asphalt Paving Co., Sioux City, Iowa, for $711,528; and a contract for construction of the diversion dam has been let to Abel & Dobson, Lincoln, Neb., for $248,492.

Land purchases amounting to 4,824 acres at a cost of $208,638 have been made. Purchases are made by the district, the PWA requiring that an outside appraiser be named, who acts as arbiter and sets the maximum price that may be paid for any piece of property.

Letters to the Editor

Training in Fundamentals

Sir—The article by Prof. Thorndike Saville, entitled "Training Civil Engineers to Meet Modern Demands" (*ENR*, June 21, 1934, p. 802) deserves careful consideration by engineering educators and by all young civil engineers. All engineers who have graduated from the universities within the last ten years should also consider this article carefully. These are the men who will soon be at the head of the profession and directing its activities.

The writer agrees with Professor Saville that there is urgent need of a better system for selecting young graduates to fill engineering positions, both in government agencies and in the construction industry as a whole. There should also be more coordination between the employing agency and the educational institutions. This coordination should be directed toward *selecting* the students best adapted to fill particular jobs rather than toward training students picked at random.

It must be admitted that no course can be prescribed in college which will fit each and every student exactly for the problems he will encounter after graduation. Therefore it is much better to give them all the fundamentals possible, in as wide a field as possible, and then let them specialize after graduation in whatever field they may find themselves. The suggestion of the author, that the courses in the senior year in college should be shortened and some of them eliminated, is not a sound suggestion, since it is certainly better to give the young graduate a good foundation in a number of fields rather than train him specifically for some phase of the work in which he cannot find an opening after he graduates. This is particularly true for those who plan to enter government service in any of the field branches. This work perhaps more than any other will call upon the young graduate to solve more problems in more different fields than he ever thought existed.

The writer offers the case of a young engineer graduate from one of the larger universities. The curriculum studied by this engineer while in the university was above the average for thoroughness in teaching the fundamentals in civil engineering. Geology, economics, hydraulics, structures, construction materials, highways, concrete design, water supply and bridge design were treated in as thorough a manner as time would permit. Other less important subjects, such as money and banking, business law and technical English, were among the subjects touched upon in a lesser degree. Soon after graduation this engineer secured a job in one of the field offices of the Engineer Department, U. S. Army, and was assigned to construction work. Eight years of continuous employment have passed since that first assignment. In this time he has been given problems to solve in the following classes of work: lock and dam construction, layout and construction of navigation channels, preparation of dredging estimates

construction of steel and concrete buildings, study of shoreline changes along ocean beaches, designs and estimates for seawalls and other marine structures, study of rainfall and runoff characteristics of two major watersheds, writing of technical reports on several streams covering their comprehensive development for flood control, navigation and power development, and special design and construction of miscellaneous structures for seacoast defenses.

It will be clearly seen from the above that although the college course studied by this young engineer was above the average both in diversity and thoroughness, still it did not train him specifically for a single one of the numerous problems he has encountered. It did, however, do better than that. It laid the foundation for all this variety of work by giving him the fundamental theories involved in the various problems that he was called upon to solve. Once such theories are understood it is easy enough to apply them to a large number of different situations and problems and to effect their solution.

The continued training of the young engineer after graduation is another phase of his education that has been sadly neglected, not only by governmental agencies but by the profession as well. After he leaves college he is left to sink or swim by his own initiative. If he is interested in the work assigned him and if he is ambitious, he digs in himself and tries to learn more about his job. If he is more or less a misfit in his job, he either learns just enough to carry on the particular work assigned or he lingers along on the work until he has to be replaced. The young engineer who learns just enough to carry on the work assigned him soon makes a rut and stays in it. He becomes afraid to venture out into new fields and consequently cannot advance in the profession. His staying in his rut does even more than that, it holds back some more ambitious young engineer who would advance where the other has failed. A little coordinated effort on the part of the engineering educators and the practicing engineers in executive and administrative positions would prevent a lot of this more or less futile wandering around in the profession. The Engineers' Council for Professional Development has made a laudable beginning in this direction, but the support of all the civil engineers in the profession is necessary to carry it on.

The following suggestions are offered for consideration by all members of the civil engineering profession:

1. Provide educational and vocational guidance for all prospective engineering students.

2. Organize the college courses in civil engineering so as to give a maximum of fundamental training in the various branches of civil engineering, with a minimum of specialization in any one branch.

3. Require a practical experience qualification for admission to graduate study.

4. Set up some agency to assist the young engineer graduate to continue his studies in whatever special branch of civil engineering he finds himself employed.

5. Provide professional recognition of the advancement of the young engineer, upon his satisfying the requirements of a high set of engineering standards.

It is believed that the carrying out of the above suggestions will do much toward fitting the young engineer to meet modern demands and will materially raise the standards of the civil engineering profession.

DAVID E. CONLEY,
Associate Hydraulic Engineer, Tennessee Valley Authority.

Knoxville, Tenn., Aug. 21, 1934.

Methods of Laying Off an Angle

Sir—In your issue of Aug. 23, 1934, p. 247, a "direct method of laying off an angle in the field by repetition" is given by Robert E. Gohl, who states that it is capable of producing a high degree of accuracy. He gives a problem of laying off an angle of 24° 20′ and advises setting the vernier on six times the angle of 24° 20′, or 146° 00′ at the sixth repetition, and setting a point on that line; then measure one-sixth the difference between that line and a line already set at first "shot" of 24° 20′, assuming "zero" vernier at first backsight.

The total error of angle will now be one-sixth of the sum of three errors—neglecting errors inherent in the transit which the instrument man cannot correct—and these errors are the imperfections and limitations of human sight and touch in, (*a*) setting the vernier at zero, (*b*) setting the vernier at 24° 20′ and, (*c*) in setting the vernier at 146° 00′.

I fail to see where the final setting of 146° 00′ does any good in this case, or where it saves any time in the field. It only adds another uncertainty without any saving of field work. At the sixth repetition—in this case—the more accurate method, and just as speedy, would be to set on *C* exactly and read the vernier which, let us assume, reads 145° 59′. The true angle first laid off is then one-sixth of that reading, or 24° 19′ 50″. Knowing this, it is then a simple matter to lay off a 10″ angle by right-angle offset method, taking care that this correction is applied in the right direction to make the angle desired, in this case 24° 20′ 00″.

One does not even have to divide the sixth vernier reading by 6. He can mentally subtract six times the initial vernier reading from the actual final sixth reading, or vice versa as the case may be, depending on which is larger. In the above case a simple mental inspection shows that the angle first laid out is one-sixth of 1′, or 10″ too small. If it had been too large, it would have been subtracted. In the above case the angle is too small, hence the 10″ is added.

Mr. Gohl cannot assume that his first angle actually laid off is 24° 19′ 50″, as he has no way of knowing it until after the other operations are completed.

I would like to see in print the opinions of other transitmen giving their favorite method in the above case. Let the question be stated thus: What is the best and most accurate method of laying off an angle containing odd seconds with a transit reading to minutes? Or, what is the best method of laying off exact minutes or fractions of minutes with a "minute" transit?

MILTON R. EVA,
Registered Surveyor.

Carp Lake, Mich., Sept. 4, 1934.

Bostwick Dam and the Bridgeton Flood

Sir—In the story of the Bridgeton, N. J., flood, published in your issue of Aug. 9, 1934, a statement is made that the dam at Bostwick's Pond failed late in the afternoon of Aug. 2. I wish to state that the dam at this pond did not not fail at the time mentioned.

At 11 p.m. on Aug. 2 there was 40 sec. ft. of water discharging over the spillway, and the earth embankment was intact. This discharge is only about two and one-half times the normal discharge. It was not raining at the pond at that time, although it had been raining before and started again about 11:30 p.m. At 2:10 a.m. Aug. 3, water was running over the top of the earth dam, in several places and had started a 25-ft. breach that was washed out at the east end of the concrete spillway. The discharge over the spillway at this time was 320 sec.-ft.

It is estimated that the breach was discharging about 70 sec.-ft., and the water running over the top amounted to about 50 sec.ft., making a total discharge of about 440 sec.ft. at that time. At 3:00 a.m. on Aug. 3 the drain gate in the spillway had been raised and the flashboards had been removed from the top of the spillway. This increased the spillway gate discharge to 700 sec.-ft., the breach discharge had increased to 180 sec.ft., and the water over the top of the dam remained the same (50 sec.-ft.), a total of 930 sec.-ft. This rate of discharge lowered the water surface in the pond about 6 in. per hour, stopping the flow over the top of the dam.

The drainage area above the Bostwick Dam is 8.5 sq.mi. and feeds the pond by four streams. The area of the pond is 50 acres under the normal head of 5 ft. This dam does not carry the county road but is privately owned. The county road is about 75 ft. south of the dam.

MORVIN L. BOSTWICK

Wenonah, N. J., Aug. 21, 1934.

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October 11, 1934

Again Road Tax Diversion!

GASOLINE-TAX DIVERSION is getting news notice again as approaching winter warns the politician of imminent demands for unemployment doles. The press dispatches from state capitols indicate a purpose to dip deeper into these highway funds than ever before. Apparently the near meeting of legislatures and a realization that after next June further steals will be penalized by reduced federal aid are prompting extra preparations for making a complete haul while it is profitable. An encouraging sign to road-builders is that most of these news reports indicate, coincident with announcement of proposed diversions, the appearance of a live organized opposition. Here and there leaders in legislatures are also showing rebellion against curtailing work relief to supply money for idleness relief. Organizations of the highway industry everywhere should extend their efforts in every direction to capitalize on the situation. Support of these organizations by joining their membership rolls is a small fee to pay for reclaiming a fifth of a billion dollars of road-users' taxes for the legitimate purpose of highway upkeep and extension.

Longer Rails

ENCOURAGING PROGRESS in the elimination of rail joints through the welding of railroad rails into long lengths was reported at the meeting of the American Welding Society in New York last week. Such welding has been common practice in street-railway service for some time past where there is less chance for the development of "sun kinks" because the rails, buried in the street pavement, are firmly restrained as to lateral movement and are less subject to violent temperature changes. But in steam-railroad service, where high temperatures frequently have caused "sun kinks" that pushed the track clear out of light or loosened ballast, the practice has been frowned upon. Now rail lengths up to 2,800 ft. have been successfully maintained with the heavier rail, tie plates and more substantial ballast bed that is common to most main-line railroads today. The rail joint always has been the railroad maintenance-man's chief source of trouble. Therefore, any development that will result in a material reduction of the number of joints will be widely welcomed.

Cooling Mass Concrete

WITH EVERY PROBLEM common to mass-concrete construction aggravated by the unsurpassed size of Boulder Dam, none was as serious as the question of the heat of hydration and associated difficulties. From experience gained on smaller structures it was apparent that an entirely new approach was essential if the complications of expansion and ultimate contraction were to be avoided and the dam made available for service within a reasonable time. Two points of attack were open: first, the amount of heat generated in the hydrating cement might be reduced; and, second, the remaining heat could be removed artificially to permit immediate grouting. The Bureau of Reclamation approached the study of both possibilities with vigor and thoroughness. As a result, a rigorous research on the fundamental properties of cement resulted in specifications that reduced the temperature rise in the mass concrete from about 40 to 30 degrees. But even this reduction still called for an unprecedented amount of cooling within the 3,200,000 cu. yd. mass of concrete in the dam. This requirement was met in the specifications by calling for artificial cooling with pipes for refrigerated water buried in the concrete. As described in this issue, the cooling method departs somewhat from that laid down in the specifications, the present operations being the result of laboratory and field study by the engineers and contractors. The nicety with which the temperatures within the mass have been reduced to predetermined isotherms of final temperature is most reassuring as to the ultimate results to be obtained.

Practical Aids to Travel Speed

BELT ROADS are being rapidly thrown around our large cities as defenses against further street congestion by through traffic. The new system of encircling highways and bridges being progressively constructed at Providence, R. I., as described in this issue, is a notable example. These intercepting highways have also the equally important purpose of providing continuous freedom of movement for the through traveler. In essence, both purposes are services to highway speed in its general sense of uninterrupted rapid progress. This meaning of speed is deserving of greater emphasis in current planning for accelerating highway travel. Generally, thought has been limited to possible velocity rates of vehicles that may be provided for in road location and structure. This consideration of higher vehicle speeds has a definite place, as was noted in our issue of Sept. 27, in planning highways for the future, but an essential complimentary movement is to provide routes on which the rate of vehicle movement is uninterrupted. Travel is accelerated as positively by the means which the belt road furnishes for avoiding halts and crawling movement of travel in city streets as by designing that road for unlimited vehicle speed rates.

Maimed Children

THE TRAGIC TOLL of children blinded, mained and even killed by blasting caps is rising at an appalling rate. Already this year the number of innocent victims seriously and horribly injured by exploders is 50 per cent greater than that of all last year. Gross carelessness alone is responsible every time a small finger or hand is blown off or the sight of young eyes is forever darkened by an exploding cap. Some types of accidents might be classed as unavoidable, but those involving blasting caps and children, never. For the sole cause lies in allowing the innocent-looking detonators to come into possession of the youngsters. As a heavy, even though sporadic, user of explosives the construction industry is partly responsible for the maiming of 500 children annually. On many jobs the use of explosives is only incidental, inimical to proper care in storing and handling. Consequently blasting caps are often lost, mislaid or so care-

lessly stored that ultimately they reach the hands of unsuspecting children. The remedy is obvious. Keep the exploders locked up in a secure place, and permit them to be handled only by responsible persons charged with the use of explosives.

Are Safety Inspectors Required?

AN ACCIDENT-PREVENTION LESSON having distinct human interest is contained in the account in last week's issue of the safety measures employed last winter for the operations of the Civil Works Administration. Contrasted with the accident frequency rates of the average construction year, the record shows remarkably few serious or fatal injuries to workmen. In a measure this favorable showing probably resulted from the simple character of many of the work-relief operations. But to offset this more favorable condition was the fact that a large proportion of the workmen were inexperienced in construction, unaware of its common hazards and often physically unfitted to avoid them.

As an accident-prevention problem the CWA work presented great difficulties: quick organization was required, education had to begin with completely ignorant learners, and the large labor turnover constantly renewed the proportion of fresh pupils. The problem's solution was constant and persistent safety inspection. Warning, instruction and formal rules played parts, and in normal construction operations their roles would have been more important than they were in this situation, but the vital safety force at work was inspection.

The great lesson of the work-relief safety program, beyond its main lesson that accident prevention is profitable, is that constant safety inspection is a vital element of success in reducing accidents. It suggests the query whether safety inspectors as well as inspectors of materials and workmanship might not well be provided for in contractual procedure. The current annual record of one man killed in every thousand of construction workmen indicates that some unusual thinking is needed.

Setting Professional Standards

CONSIDERATION of the subjects that were on the program of the meeting last week of the National Council of State Boards of Engineering Examiners at Portland, Ore., indicates that that organization has been carrying forward for the engineering profession activities that should have been carried forward by a national professional organization had there been a strong organization of that character in the engineering field. Some of those activities, such as the accrediting of engineering schools, fall naturally into the field of the Engineers' Council for Professional Development, formed about two years ago, and others will fall into the field of the recently formed National Society of Professional Engineers if it comes up to the expectations of those who organized it. Such activities, therefore, should be transferred to the new organizations as soon as possible.

Minimum educational requirements for students of engineering and minimum requirements for recognition as an engineer should be established by the engineering profession for the examining boards, not by the boards for the profession. This is said in no disparagement of what the National Council of Engineering Examiners has done in the past. It stepped in and undertook to establish standards and to determine policies that affected its affairs when the profession lacked facilities to take like action. Now that such facilities are being developed, it can leave the policy forming to the newer organizations.

Further, there is good reason to believe that the immediate interest of engineering examiners will swing toward the policing functions of examining boards as registration laws find wider acceptance and become more firmly established, for under these circumstances the examining boards will be in a position to question the legality of practices that could not be attacked successfully now. Whether in this work the Council will again find itself in the position of having to establish policies depends largely upon how quickly the National Society of Professional Engineers grow to full stature. If it develops strength quickly, it should soon be able to take the lead in defining the fields in which the policing functions of license laws should be called into play

Prosaic But Promising

A MORE PROSAIC subject for investigation than shelf angles can hardly be imagined. Yet the results of the first year's tests by the structural steel welding committee of the American Bureau of Welding are instructive and in some respects significant. The program included load tests on full-size welded specimens and connections as well as a photoelastic study of half-size angles. If some of the results might have been predicted, such as the presence of tension on the top of the side welds in addition to the shear, there was nevertheless obtained a qualitative picture of the dominating importance of this tension, which promises to point the way to a rational theory of design. It is also important to know that concentrated loads are no more severe than, and indeed act quite similar to, loads distributed along the full length of the outstanding leg. While this has been assumed to be the case for riveted shelf angles, with rivets on the center line of the vertical leg, it was not evident that it would hold when the connection was made by welds along the edges only.

From an economy standpoint it is useful to know that welds longer than are dictated by requirements of the vertical shear contribute no additional strength and constitute so much waste metal; also that increasing the size of the weld does not give a proportionate gain in weld-strength. What is probably the most significant result of the investigation came from the photoelastic studies, which demonstrated quite conclusively the advantage of long-radius fillets on shelf angles. Such fillets not only give the outstanding leg increased bending resistance, they also decrease the controlling compressive stress materially at a point where it is a maximum—namely, across the fillet at an angle of 20 to 30 deg. with the vertical. This result is quite as important to riveted as to welded construction. The structural steel welding committee deserves commendation for continuing its practice of taking no riveted precedents for granted where welding is concerned. This trait of universal curiosity not only may lead to complete knowledge of welded shelf angles, but conceivably it might develop a more efficient new detail that would eliminate seat angles entirely. In such an event the full promise of the present investigation would indeed be achieved.

CURRENT NEWS

Construction Operations Start On Parker Dam Project

Preliminary construction work on the Parker Dam unit of the Colorado River aqueduct project of the Metropolitan Water District has been started by the Six Companies Inc., with the building of temporary camp buildings and water and power lines. Work on the dam will be carried forward from a construction town to be called Whipple, located on the California bank of the Colorado River about 150 miles below Boulder Dam. The new community is named for Lieut. Amiel Weeks Whipple, who conducted the first survey of the region from San Diego, Calif., to the Gila River, in 1849. The Six Companies Inc., will obtain electric power from the system serving the Metropolitan Water District, which supplies energy to all camps along the aqueduct line. Water for camp purposes will be pumped directly from the Colorado River.

State Highway Officials To Meet in Santa Fe

The twentieth annual convention of the American Association of State Highway Officials will be held at Santa Fe, New Mexico, Nov. 12-15. Among the principal speakers and topics scheduled for the convention are:

An address by Thomas H. MacDonald, chief of the Bureau of Public Roads, on some phase of federal highway activity; "Airports as a State Highway Responsibility," by J. Carroll Cone, Department of Commerce; and an address by Senator Hayden of Arizona, presenting suggestions to state highway officials as the result of his experience with federal legislation.

Because of the increasing importance of highway safety, this subject will be presented in an address by A. B. Barber, U. S. Chamber of Commerce, on "Necessity for Uniformity in Highway Laws." Several talks will be given along the general line regarding matters of regulation and policing. The subject of "Roadside Planting and Development" will be treated by M. W. Torkelson, director of regional highway planning in Wisconsin.

Small Dams Proposed As Major Feature of Ohio Relief Work

A plan for the building of thousands of small dams on farms throughout the state of Ohio is being considered as one of the major points of attack in the state's relief program for the coming winter. The plan is credited to David Warner, executive secretary of the Ohio Water Conservation Board. Already nearly 100 applications for such dams are on file, and the department is expected to grant approval of the plan at an early date to allow a start on the program. If the program is carried out according to present plans of the water conservation board and the director of state relief, Frank D. Henderson, it would result in the construction of nearly 1000 reservoirs before next spring.

U.S. Supreme Court Refuses to Review Sewage Patent Case

ON October 8 the United States Supreme Court denied a request by the city of Milwaukee to review a decision of the Court of Appeals which held that the patents on the activated-sludge process of sewage treatment, licensed in this country to Activated Sludge, Inc., were valid and had been infringed by that city.

Judge F. A. Geiger, of the United States District Court in Milwaukee, held on Feb. 7, 1933, that the patents were valid and had been infringed by Milwaukee, in a suit brought by the company. The court rejected the city's claim in defense that the patents were invalid because independent and earlier invention should be ascribed to Harry W. Clark at the Lawrence Experiment Station and to Harrison P. Eddy at Worcester, Mass. Milwaukee's sewage treatment plant, which uses the activated-sludge process, was put into operation in 1925, well within the life of the patents. (*ENR*, Feb. 23, 1933, p. 264.)

Milwaukee appealed the decision of the trial court but on March 2, 1934, the United States Circuit Court of Appeals for the Seventh Circuit affirmed it. (*ENR*, March 8, 1934, p. 334.)

Similar action was brought against the Sanitary District of Chicago some years ago. Although the case has been heard a decision has never been rendered. Suits have also been filed against a number of other cities using or planning to use the process. According to Activated Sludge, Inc., 31 cities have now been licensed to use the process, at a charge of 25 cents per capita.

Farnam St. Bridge Project In Omaha Revised

New bids have been taken for a bridge over the Missouri River between Omaha, Neb., and Council Bluffs, Iowa. Located on an extension of Farnam St., Omaha, the bridge would be a block downstream from the existing street railway and toll bridge, which the city after negotiations refused to buy. First bids on the Farnam St. crossing were taken on March 1, 1933, and the Great Lakes Dredge & Dock Co. of Chicago, the only bidder, offered to take the bonds of the Omaha-Council Bluffs Missouri River Bridge Trustees in payment. This contract did not materialize, and the present bids represent an attempt to revive the project.

In the new bidding which also stipulated that the contractor arrange for financing, three bids were received, the low bid of $2,075,000 being submitted by the Minneapolis Bridge Co. to cover the two 471-ft. river spans and 4,000 ft. of approaches on concrete piers. Other bidders were the Illinois Steel and Bridge Co., of Jacksonville, Ill., and the Great Lakes Dredge & Dock Co., although the latter made no offer to arrange for financing or to accept bonds in payment. Robinson & Steinman, New York, are consulting engineers for the bridge trustees.

Two other bridge projects at Omaha have recently been in the news. One of these, some 4 miles downstream from Farnam St., is under construction by the Kansas City Bridge Co. It is known as the South Omaha or O Street bridge. The second project, about four miles upstream from Farnam St., is still in the planning and promotion stage. It is known as the Florence bridge. For both of these projects, Ash, Howard, Needles & Tammen, Kansas City, are consulting engineers.

Proposed Atlantic-Gulf Canal Project Found Uneconomical by PWA

The proposed Atlantic-Gulf ship canal across Florida has been reported upon by a special board of engineers at the request of the PWA and found to be outside of the normal, self-liquidating requirements for repayment and amortization. The board reporting on the project concluded that the proposed canal could earn operating and maintenance expenses, but would not retire a bond issue, even at the 2% interest rate, within a reasonable period. Further, the loan necessary for the construction of the canal could not be repaid without interest in less than 80 years. The estimated cost of a 30-ft. sea-level canal was $143,000,000 exclusive of interest during the 6-year construction period.

The board was composed of Walter J. Douglas, chairman, Col. Warren T. Hannum, and Maj. Brehon Somervell, Corps of Engineers, Clarence McDonough, director of engineering of the PWA, and Frederick H. Fowler, PWA Board of Review.

The report states that, "Based upon the best available data and an investigation of the shipping which could economically use the canal, the board is of the opinion that tolls should not exceed an average of 8c. per net registered ton. The estimated revenue on this basis would equal approximately 75 per cent of the total estimated ship operating costs for the time saved by vessels transiting the canal.

"The revenue accruing from a toll of 8c. per net registered ton upon the estimated shipping, plus revenues from local traffic and non-cargo vessels, would not retire a bond issue even at a 2 per cent interest rate.

"The canal would earn operating and maintenance expenses and theoretically the cost of construction could be repaid without interest in 80 years. However, a forecast for such an extended period is of doubtful value. Without repaying the cost of construction, revenues derived from tolls at 8c. per net registered ton would pay operating and maintenance expenses and an average of about 1.3 per cent per annum.

Proposal to Use Relief Labor On Colorado Aqueduct Tunnels

Directors of the Metropolitan Water District, southern California, have authorized the filing of an application with the state emergency relief administration for construction by SERA forces of more than ten miles of tunnels on the Colorado River aqueduct distributing system. Aqueduct tunnel work covered in the district's application includes the Pasadena tunnel, 2.3 miles long, located under Mountain St. in Pasadena, and the Monrovia tunnel, 7.8 miles long, located along the lower south slope of the San Gabriel mountains north of the cities of Monrovia, Arcadia, Glendora and Azusa. Construction of the tunnels by workers employed and paid by the SERA, it was pointed out, would result in a saving to the water dstrict and at the same time provide employment for approximately 4,000 men during the coming winter months.

New Orleans Highway Claim Upheld by State Supreme Court

Refusal of the Louisiana Supreme Court to grant a re-hearing in the case of New Orleans against the Louisiana Highway Commission, requiring the payment of $175,000 due March 31, 1934, as the quarterly installment of $700,000 set aside for use of the city in the constitutional amendment, has closed the legal contest in this case in favor of the city. The constitutional amendment providing for a $75,000,000 bond issue for paved highways and bridges, to be financed by a gasoline sales tax, stipulated that $700,000 was to be paid to the City of New Orleans annually from the gasoline tax revenues for the maintenance of streets which were a part of, or are incidental to, the state highway system.

The state highway commission refused to make the quarterly payment for the first quarter of 1934 on the ground that the funds were not being devoted by the city to street work. As a result, the city filed suit in the state court and won the judgment ordering the commission to pay the installment, and to set aside $525,000 to cover the remainder of the year's payment. The state supreme court, on July 2, handed down a decision affirming the judgment of the lower court, and authorizing the Highway Commission to make expenditures as required.

RFC Continues Selling of Bonds Held by PWA

Municipal bonds held by or pledged to the Public Works Administration in its program of non-federal public works financing with a total value of about $4,000,000, were offered for sale Oct. 1 by the RFC. This sale carries forward the RFC operations in disposing of municipal securities held by the PWA for the purpose of placing these bonds in private hands, so that additional funds will be available for carrying forward the PWA operations.

The largest individual issue is a block of $801,000 4 per cent bond interim receipts of the Maryland State Roads Commission. The next largest issue is one of $613,000 of 4 per cent harbor district bonds of Orange County, Calif.

Welding Society Meeting Featured by Reports on Seat Angle Investigation

FROM a civil engineering and construction viewpoint the fourteenth fall meeting of the American Welding Society held in New York Oct. 1-5 was notable chiefly for the reports on the welded seat angle studies sponsored by the Structural Steel Welding Committee. Also of significance was a session devoted to railway welding in which the experience of the D&H Railroad with rails welded into lengths up to 2,800 ft. was described. Among a number of important papers, a review of all existing tests on impact resistance of welds, domestic and foreign, by W. Spraragen, secretary, American Welding Society, was notable. The Miller Memorial Medal was awarded to J. C. Lincoln, chairman of the board, the Lincoln Electric Co., Cleveland, in recognition of his many contributions to the art, the most recent and important of which was the introduction of a shielded arc method suitable for general industrial use.

Welded seat angles

The welded seat angle reports, of which there were three covering, respectively, the laboratory tests, a photoelastic study and an analytical study of ultimate strength formulas, are the first on this new project of the Structural Steel Welding Committee being carried out at the Fritz Engineering Laboratory, Lehigh University, under the supervision of Prof. Inge Lyse. Norman G. Schreiner and Douglas M. Stewart, of the laboratory staff, reported on the physical tests and the photoelastic studies, respectively, with Prof. C. D. Jensen of the civil engineering department discussed the test results in relation to analytical design.

Physical tests

Test specimens consisted of two angles welded along the ends of the vertical legs to either side of a plate, with the load applied at three different positions on the outstanding legs. In addition two full size connections were tested, consisting of seat angles welded to stub columns and supporting a 20-in. I-beam held in place by tack welds between the flange and the outstanding leg. The angles were cut to a length of 8 in. In all cases the outstanding leg was 4 in., while the vertical leg was 4, 6 or 8 in. The thickness varied from ½ to 1 in.

In the study three types of action in a welded seat angle under load were recognized: (1) vertical shear in the weld, (2) bending of both angle legs and tension in the upper part of the weld, and (3) bending of the angle longitudinally, with tension in the upper part of the weld.

The following were among the conclusions drawn from the tests reported upon:

(1) The strength of a welded seat angle connection varies roughly as the square of the thickness of the angle, directly as the effective lever arm of the resultant reaction, and is influenced by the length of the vertical leg of the angle and the size of the weld.

(2) Vertical shear has only a slight effect on the strength of the weld unless the angle is so thick that the bending deflection of the vertical leg is reduced to a minimum. In any case, the tops of the welds are most highly stressed and fail first.

(3) The centers of rotation for the calculation of the resistance of the weld, although not located definitely, were not at the midheight and probably vary with the effective lever arm of the applied load and with the load itself.

(4) The outstanding leg seems to distribute a concentrated load so that the resultant moment has the same effect on the welds as if the load were spread over the full length of the angle.

(5) As the load on the outstanding leg moves in toward the heel of the angle, true cantilever action is replaced by a combination of bending and vertical shearing stress, giving a point of maximum principle stress on the fillet of the angle.

(6) Increase in size of weld increases the strength of the connection but not in proportion to the gain in weld strength, indicating the economic desirability of small welds.

(7) The strength of the connection does not increase markedly with the length of the weld so that the weld probably need only be slightly longer than is necessary to prevent shear failure.

(8) The failure of this type of connection is gradual unless the lever arm is so small that shear and not bending predominates.

(9) The position of the resultant reaction from a beam is dependent upon the relative stiffness of the beam flange and the angle.

Photoelastic studies

In the photoelastic studies, which necessarily were two-dimensional, only the lateral bending effect of the angles themselves could be investigated and compared with the results of the physical tests. However, it was possible also to study the distribution of stress in the angles and to obtain the value of the extreme fiber stress in the outstanding legs, the latter permitting evaluation of fillets of various radii. From the photoelastic studies the following conclusions were indicated:

(1) Provided shear failure is prevented, the limiting condition for permanent set in the connection is determined by the bending strength of the angles.

(2) The maximum compressive strength at the fillets of the angle is about 1½ times the maximum tensile strength along the top side of the angle.

(3) The maximum stress, end slope and deflection for a constant lever arm, varies linearly with the load.

(4) For a given load, the maximum stress varies linearly with the lever arm of the load, and the end slope and deflection under the load vary as second and third order parabolas, respectively.

(5) The addition of a small percentage of material in the form of a larger fillet in the angles gives marked reductions in both tensile and compressive stresses.

(6) The length of the vertical leg has little or no effect on the stresses in the angle above a length equal to that of the outstanding leg; sufficient length must be provided, however, to prevent failure by shearing of the welds.

(7) The strength of the seat angle itself in bending is governed by the section modulus of a cross section of the outstanding leg.

(8) The greatest tensile stress in the angle occurs directly above the point where the fillet commences, while the greatest compressive stress occurs on the fillet at an angle of from 20 to 30 deg. with the vertical.

(9) The vertical shearing distribution is not uniform on any section of the angle, and on sections near the back of the angle shows a reversal of sign. The maximum vertical shearing stress may be as high as five times the average stress over the section.

Designing welded seats

In his discussion of the welded seat angle problem, Professor Jensen examined various possible formulas in an attempt to secure one that would predict — logically and accurately—the ultimate strengths of the connections as found in the tests. Prediction based on the existence of shear

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PWA Rescinds Loan For Verde Project in Arizona

THE tentative allotment of $4,000,000 to start construction of the Verde River power and irrigation project in Arizona has been rescinded by Administrator Ickes. According to a report released by the PWA a check made on the cost of the project indicated that the development was unable to meet PWA requirements as to repayment of capital investment within a reasonable time.

Rescission of this allotment was based on a recommendation of the Bureau of Reclamation which has completed a reexamination of the project and is in accord with the PWA policy of approving only self-liquidating irrigation and power projects. The preliminary estimates which formed the basis for the tentative allotment for the Verde project indicated that it could be built at a total cost of $18,912,000 and would irrigate 85,000 acres of land at an estimated cost of $160 per acre. With the award of the tentative allotment, Administrator Ickes directed a thorough study and review of the estimate before the government finally approved the project.

This study, made by a special board of engineers reporting to the PWA, revealed that the project would cost about $10,000,000 more than the original estimate and that the irrigable area would be less than 31,000 acres.

The report concluded: "The resulting estimated construction cost of $472 per acre is extremely high, and even though the annual charges per acre are credited with anticipated returns from power sales and carriage of Indian water, they still remain, in our opinion, at such a high figure as to be beyond the ability of the land to repay. An uncertainty will exist as to water supply until all rights to the use of the Verde River are fully adjudicated.

"In view of the above, in our opinion, the project is not feasible and its construction should not be undertaken by the United States."

The report was signed by R. B. Williams, construction engineer; and concurred in as to water supply by E. B. Debler, hydraulic engineer; plans and estimates for dams, B. W. Steele, senior engineer-dams; and plans and estimates for power and pumping, L. N. McClellan, chief electrical engineer. Dr. Elwood Mead, Commissioner of Reclamation, forwarded the report to Administrator Ickes and recommended rescission of the allotment.

The proposed Verde project contemplated the irrigation, by storage and diversion of a part of the flood waters of the Verde River, of irrigable lands in Paradise and Deer Valleys, about 15 miles north of Phoenix. The proposed development included three power plants with total installed capacity of 30,000 kw. With respect to this phase of the proposed development the report stated:

"Under the present depressed condition of the mining industry in Arizona it appears unlikely that any appreciable amount of additional power can be marketed commercially at this time."

Federal Suit on New River Dam Answered by Defendants

The suit of the federal government to stop the construction of a power dam on the New River near Hawk's Nest, W. Va., has been answered jointly by the Electro Metallurgical Company, the New-Kanawha Power Co., and the Union Carbide & Carbon Corp., with the assertion that the stream is not navigable and therefore the federal government has no authority for exercising control over the project.

The government's suit, filed last June was reported at that time to be a direct assertion of the government's right to regulate the stream flow of navigable rivers. The petition of the government charges that the project has proceeded without lawful authority because it was licensed only by the state and did not have the approval of the Federal Power Commission or any other government agency. The state supports the company's contention.

Large Erosion Control Project To Be Started in Arizona

One of the most comprehensive land conservation projects for the control of erosion, flood prevention and land management to be undertaken by the Soil Erosion Service will be started soon on the upper watershed of the Gila River in Arizona and New Mexico. An allotment of $250,000 for preliminary work on the project has been made by H. H. Bennett, director of the service, with the approval of Administrator Ickes. The money will come from the recent PWA allotment of $10,000,000 for this type of work.

The area involves more than 8,000,000 acres on the drainage basin of the Gila River where erosion and destructive floods have devastated areas of fertile soil and menaced irrigation systems. The initial work on the project will consist mainly of surveys which will form the basis for the development plan. All but 3 per cent (246,000 acres) of the land is owned by the federal government.

According to a survey made by the erosion service in investigating this project the San Carlos Reservoir behind the Coolidge Dam is being rapidly threatened with silt deposits.

Tax on Sanitary Sewer Service Instituted at Dallas, Texas

A sanitary sewer tax, instituted for the purpose of raising $262,000 to provide for interest and sinking funds for outstanding sanitary sewer and disposal plant bonds, was placed in effect at Dallas, Tex., Oct. 1, by ordinance of the city commission. The ordinance was passed to provide this source of revenue over the opposition of the local taxpayers league and other property interests. The sewer charge is 25c. a month to minimum users with the tax graduated, starting at 20c. per month for a connecting charge, plus 2½c. per 1000 gal. of water used for sewage disposal purposes. Under the schedule, it is estimated that 90 per cent of the consumers will not be taxed more than 45c. per month. According to announced plans, the billing for the sewer charge will be attached to statements issued by the water department each month and failure to pay will result in disconnection of water service.

National Society of Engineers Approved in Oregon

ENDORSEMENT of the newly organized National Society of Professional Engineers was voiced by professional engineers of Oregon at the recent western conference of the national body held in Portland, Ore., Aug. 3, and officers of the Oregon society were requested to submit the question of affiliation with the national society to the membership at an early date. The meeting of the national society was held in conjunction with the 15th annual convention of the National Council of State Boards of Engineering Examiners held Oct. 4-6. Both organizations voted to hold their 1935 convention in Columbus, Ohio.

At the professional engineers session the principal speaker was D. B. Steinman, New York City, president of the National Society of Professional Engineers, who explained the organization and the purpose of the society to the Oregon group.

The council of engineering examiners, in their meeting, approved the program of the Engineers' Council for Professional Development, for accrediting engineering schools, minimum definition of an engineer, uniform membership grade in national societies and certification into the profession.

Committee reports were submitted on: accredited engineering schools, uniform examination for registration, a national bureau of engineering registration, engineers' council for professional development and the constitution of the organization.

A resolution was adopted, which is to be sent to various departments of the federal government, urging that only registered engineers and surveyors be employed in states which have laws requiring such registrations, and that employees of the PWA, FERA, and HOLC be designated as "engineers" only if they have such recognized standing in the engineering profession.

Officers for the coming year are: Ralph J. Reed, Los Angeles, president of the California State Board of Registration for Civil Engineers, president; Harry T. Ford, Columbus, Ohio, vice-president; F. H. Graf, Corvallis, Ore., director of western zone; and H. B. Mendenhall, Tallahassee, Fla., director of the southern zone. T. Keith Legaré, Columbia, S. C., was re-elected executive secretary.

Ohio River-Lake Erie Connection To Receive Further Study

As a result of information obtained during a public hearing held Sept. 17, to give proponents of the various routes being considered for a canal between the Ohio River and Lake Erie, the Board of Engineers for Rivers and Harbors has decided to secure further factual data. The board is to request the division engineer at Cincinnati, Ohio, and the district engineer at Pittsburgh to undertake supplemental investigations. These studies will be expedited to enable the board to complete its review of the subject and to make its recommendations with the least delay.

Board Meets to Study Reports on Low Flow in the St. Lawrence

Low-flow conditions in the St. Lawrence River which have seriously impeded navigation, emphasized the recent meeting of the Interdepartmental Water Levels Board in Ottawa to review data accumulated during the summer on the problems resulting from low water in the river and at Montreal harbor. The meeting is the first of a series which will be called to study information on river levels, obtained by the various departments of the Canadian government.

The water levels in the St. Lawrence river are lower this year than any other year of record. Shipping has been seriously handicapped and, as a result, the reported increased use of the ports in this country for the export of grain has resulted in further urging of the present study by the city of Montreal.

For the present the study of the board is confined to the waterway between Montreal and Quebec, but the field of study may be extended inland to the head of the lake and tributaries of the river.

The committee is working under the direction of N. B. McLean, chief engineer of the River St. Lawrence ship channel.

Mexico Appropriates $1,300,000 For Dam on Irrigation Project

To provide a water supply for more than 100,000 acres of land in the lower Rio Grande Valley, the federal government of Mexico has appropriated about $1,300,000 for the construction of a dam on the San Juan River. The project will carry forward a plan which was conceived about 25 years ago, when work was started on a dam and canal system which would have involved a total expenditure of about $25,000,000. At that time the project planned the irrigation of about 1,000,000 acres of land.

Preliminary surveys and plans for the project are actively under way, under the direction of Adolfo Alba, head of the department of irrigation of the Mexican government. The site of the proposed dam is a few miles above the junction of the San Juan and Rio Grande Rivers. The irrigable area is suited to the growing of citrus fruits and other products which are now cultivated extensively on the American side of the river.

SOCIETY CALENDAR

INTERNATIONAL CITY MANAGERS ASSOCIATION, annual conference, St. Louis, Oct. 15-17.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Santa Fe, N. Mex., Nov. 12-15.

CANADIAN INSTITUTE ON SEWAGE AND SANITATION, first annual meeting, Toronto, Oct. 18-19.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, twelfth annual convention, Chicago, Oct. 24-26.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., Dec. 6-7.

AMERICAN ROAD BUILDERS, annual convention, Washington, D. C., Jan. 22-25.

NEW YORK SECTION, AMERICAN WATER WORKS ASSOCIATION, fall meeting, Buffalo, Oct. 11-12.

MISSOURI WATER AND SEWERAGE CONFERENCE, tenth annual meeting, Carthage, Mo., Oct. 15-16.

NEW ENGLAND BUILDING OFFICIALS CONFERENCE, semi-annual meeting, Hartford, Conn., Oct. 23.

Welding Society Meeting Report

(Continued from p. 477)

only, gave results far too high. Likewise a prediction based on bending only where the two welds were assumed to resist the bending moment by pivoting about the mid-height of the vertical leg of the angle, gave results that were much too high. Another method which took into account shear plus bending, where the effective depth for calculating the section modulus was taken at six times the thickness of the angle, gave good correlation. In this method the shearing stress equals the total load divided by the total length of welds and the bending stress equals the bending moment divided by the section modulus. The resultant R of these two stresses was used in a formula for predicting the ultimate load W as follows:

$$W = 2R\sqrt{\frac{1}{L^2} + \left(\frac{c}{6t^2}\right)^2}$$

where L is the length of one weld and t the angle thickness. A fourth method similar to the above but neglecting the effect of shear gave the formula:

$$W = 12Rt^2/c$$

Both of these methods gave good correlation with actual test results, Prof. Jensen expressing a preference for the one which combines shear and bending stresses.

Long railroad rails

Recent experiments in welding railroad rails into long lengths was the subject of one of three papers before a session devoted to some features of the application of welding to the railroad field. H. S. Clarke, engineer, maintenance-of-way, Delaware & Hudson R.R., described two test sections of track in which his company had welded rails in the track into lengths up to 2,800 ft. In the first section, in the southbound track near Albany, laid in August 1933, rails on one track were first welded into 500-ft. lengths, and subsequently several of these lengths were welded together. Later two joints failed due to defective welding and three failed during the extremely cold weather of last winter. These three joints all were among those made in welding the 500-ft. lengths together, when difficulty was encountered in drawing the lengths together. No failures occurred in the 2,800-ft. length in the northbound track made by welding the joints consecutively.

In May of this year the D. & H. welded 250 joints near Mechanicsville, N. Y., to make 4 rails, each about 2,000-ft. long. Mr. Clarke cited experience in Europe and Australia on welding long rails in which it had been found that the actual expansion of the rails was only about one-half the theoretical. He stated further that with the present-day heavy track construction in this country the forces resisting rail movements are such as to reduce the actual expansion to about one-third the theoretical. In the long lengths of rail in the D. & H. tracks Mr. Clarke estimates that the stresses developed within the rail due to a 100-deg. change in temperature are well within the elastic limits of the steel.

The welding on the D. & H. was done by the thermit process. Successful electric flash welds have been made in the shop but no equipment has yet been developed that can be used successfully in the field on the large rail sections now generally employed.

Col. W. J. Barden Retires; Head of Rivers and Harbors Board

Col. William J. Barden, senior member of the Board of Engineers for Rivers and Harbors, War Department, retired from active service in the Corps of Engineers on Sept. 30, having reached the retirement age of 64 on Sept. 9. For the present he will remain in Washington.

Colonel Barden has devoted most of his time to the work of the Board of Engineers for Rivers and Harbors since his transfer to the office of the Chief of Engineers at Washington, D. C., in 1932. Previous to that time he served as division engineer, Northeast Division, New York, from 1927 to 1932, and as division engineer North Pacific Division, Seattle, from 1923 to 1927. Before going to Seattle Colonel Barden served as district engineer at Jacksonville, Fla., and also at Muscle Shoals. During the World War he was promoted to the rank of colonel and made chief engineer of the Ninth Corps in France.

Following the war with Spain, Colonel Barden saw varied service in Cuba including service as chief engineer of the city of Havana for nearly two years.

Brief News

DEMOLITION of old buildings on the site of the new Postal Terminal building of Montreal has been completed, but the beginning of excavation work has been delayed pending a decision on whether to use hand labor or excavating equipment in moving the 36,000 cu. yd. of material, since the contract for the work is under the jurisdiction of the present public works program.

PAYMENT of $30,000 to Activated Sludge, Inc., has been authorized by Providence, R. I., in settlement of patent claims on equipment to be used in completing the city sewage disposal plant.

A TABLET in memory of William Barclay Parsons, chief engineer of the first subway system built in New York City, was unveiled in St. Paul's Chapel, Columbia University, New York, on Oct. 1. In addition to his extensive activities in engineering, General Parsons served as a trustee of Columbia University from 1897 until the time of his death in 1932, and as chairman of the trustees from 1917 until 1932. General Parsons graduated from Columbia College in 1879.

CONTRACT for the construction of sanitary sewers in Houston, Texas, has been awarded, subject to PWA approval, by the city council to Russ Mitchell, Inc., for $156,563.

BIDS WILL BE OPENED Nov. 1 by the Louisiana Highway Commission for construction of 8 miles of concrete highway providing approaches for the new $1,000,000 bridge spanning the Atchafalaya river. The bridge is nearing completion and a strict time limit will be placed on the highway approach construction contract because of the desire to open the bridge for traffic without unnecessary delay.

FORT WORTH, TEXAS, and Tarrant County have agreed upon financing a $1,000,000 city-county road improvement project by sale of bonds.

Personals

W. A. PEARSON, city manager of Compton, Calif., has resigned to become consulting engineer for the San Marino, Calif., school district.

JULES HANIQUE, former engineer of the CWA in Los Angeles county, has been named city manager of Compton, Calif.

J. STANLEY EVANS, engineer in charge of grade crossing elimination and bridge construction, Columbus, Ohio, has been named chief designing engineer for the new Main St. bridge.

BRIG. GEN. GEORGE B. PILLSBURY, now assistant chief of engineers, Corps of Engineers, has been appointed senior member of the Rivers and Harbors Board. General Pillsbury had previously served as a member of the board.

H. CLAY HENNING has been promoted to division engineer of the St. Louis water department. He was formerly senior civil engineer in the department. The vacancy was filled by the appointment of PAUL H. MURPHY, the mayor's secretary.

L. M. ZAPP, consulting engineer of Louisville, Ky., has been appointed chief engineer of the State Public Service Commission. Mr. Zapp is a native of Louisville and graduated from Purdue University in 1902. After early design and construction experience he served for several years with both the New York Water Supply Commission and the Philadelphia Rapid Transit Co.

JULIAN MONTGOMERY of Wichita Falls, Texas, has been appointed state PWA engineer by Administrator Ickes. Mr. Montgomery is a graduate of the University of Texas and former city engineer of Sherman and Wichita Falls, former assistant state highway engineer and recently state planning engineer. He filled the position recently vacated by the resignation of R. A. Thompson.

Obituary

J. CHARLES ANDREWS, vice-president and treasurer of the Turner Construction Co., New York City, died Oct. 1.

ROBERT N. CRAPSTER, division engineer for the Louisville & Nashville Railroad, died Oct. 2 in Birmingham, Ala. at the age of 44.

FREDERICK CRANE, for over 50 years prominent in Boston contracting and building activities, died on Oct. 4 at the age of 73.

HENRY H. CARTER, Boston, Mass., civil engineer, died at Brookline, Mass., Oct. 4. He was 77 years of age.

ROBERT H. CUNNINGHAM, superintendent of the water department at Saugus, Mass., and for 15 years head of the town's construction department, died Oct. 6 at his home in Saugus.

CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING awards for the short week caused by Columbus Day holiday total $17,333,000 of which $14,648,000 represents state and municipal, $1 568,000 federal, $16,216,000 total public, and $1,117,000 private awards. Both federal and private awards are lower than the previous 4-weeks' average, federal awards, 66 per cent, and private awards 77 per cent below. Federal awards for the short week are off 93 per cent from last year's October average.

Highway awards for the 4 days total $5,649,000; public buildings, $3,546,000; bridges, $2,824,000; sewerage, $1,031,000; waterworks, $720,000; earthwork, irrigation, drainage and waterways, $981,000; commercial buildings, $455,000; and industrial buildings, $644,000.

The larger awards for the week include: addition and alterations to high school, Sioux Falls, S. Dak., $560,000; highway awards by Kansas, $403,000 and by Oregon, $551,000; bridge over Missouri River for Board of Trustees, Omaha-Council Bluffs Missouri River Bridge, $2,075,000; sewage treatment plant and sewers, Great Neck, N. Y., $607,000; Pier 32, North River, New York City, $689,000; and power equipment for Houston Street Line, Board of Transportation, New York City, $560,000.

State and municipal bond sales for the week at $7,529,000 are higher, due both to a larger number of sales and several large issues. Net non-federal increase in PWA allotments total $1,131,000, although a net reduction of $4,988,000 is reported in federal allotments due to rescission of $4,000,000 for the Verde power and irrigation development in Arizona and $1,098,000 for post offices. Only $110,000 in two federal allotments offsets these deductions.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Oct. 1933	Prev. 4 Weeks	Week Oct. 11 1934
Federal Government	$15,604	$4,456	$1,568
State and municipal	14,065	15,727	14,648
Total public	$29,670	$20,183	$16,216
Total private	5,733	4,873	1,117
Week's total	$35,405	$25,056	$17,333
Cumulative to date: 1933	$744,632	1934	$995,217

NEW PRODUCTIVE CAPITAL

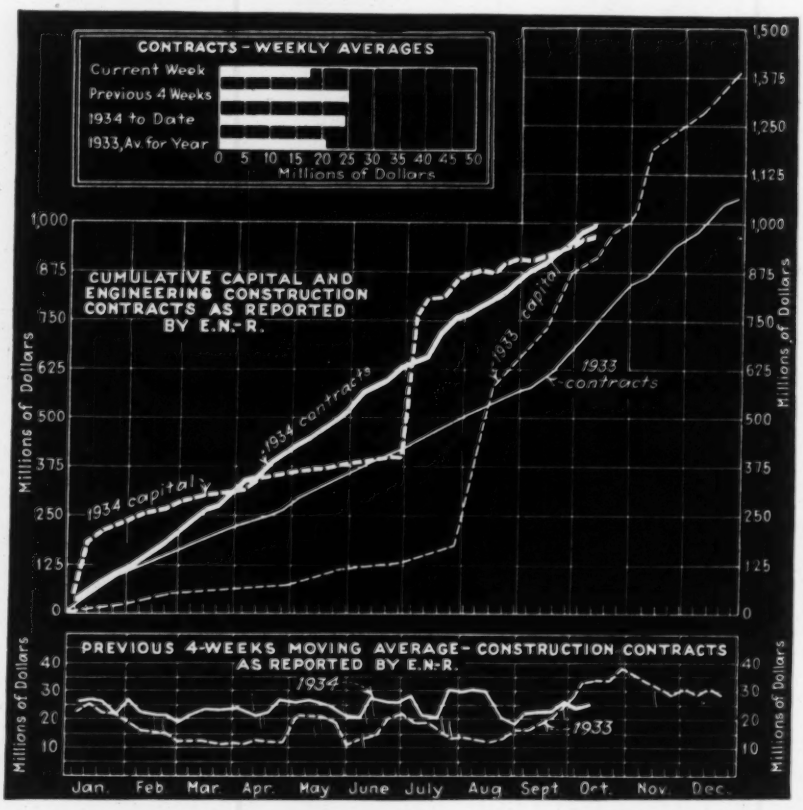
(Thousands of Dollars)

1934	Week Oct. 11	Cumulative
State and municipal	$7,529	$263,633
PWA allotments, S&M	1,131	605,905
RFC loans, S&M	....	25,463
Corporate issues	50	18,256
PWA allotments, private	....	57,022
Total, Non-Federal	$8,710	$970,279
PWA allotments, Federal Constr.	—4,988	188,788
Total new capital	$3,722	$1,159,067
Cumulative to date: 1933	$917,635	1934	$970,279

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction.

INDEX NUMBER

E.N.-R.-Cost	1913 = 100	1926 = 100	E.N.-R.-Volume	1913 = 100	1926 = 100
Oct., 1934	**200.86**	**96.55**	**Sept., 1934**	**101**	**44**
Sept., 1934	200.58	96.41	Aug., 1934	94	42
Oct., 1933	187.74	90.24	Sept., 1933	122	53.5
1933 (Av.)	170.18	81.80	1933 (Av.)	102	45
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56
1931 (Av.)	181.35	87.17	1931 (Av.)	220	96.5



Current Construction Unit Prices

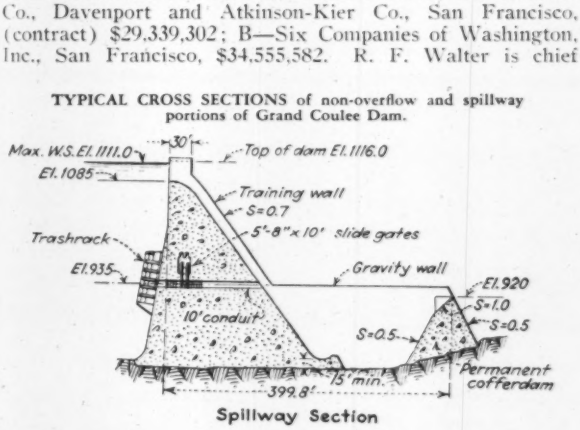
Grand Coulee Dam, Washington

THE BUREAU OF RECLAMATION let the contract for Grand Coulee Dam, in Washington, late in August on bids opened June 18, 1934. Only two bids were submitted. Present plans call for a concrete gravity section dam about 300 ft. in maximum height, with an overflow section 1,800 ft. long, and two non-overflow powerhouse sections 592 and 754 ft. long. Future plans call for raising the dam to 500 ft., resulting in a crest length of 4,000 ft. The low dam will contain 3,100,000 cu.yd. of concrete; the high dam 9,250,000 cu.yd. Excavation for the ultimate project is to be done now. Final plans call for installation of eighteen 105,000 kw. power units, nine on each end of the dam. At present three of these units will be installed at the extreme left end. Penstocks will be installed for future units. A permanent cofferdam of concrete will be built downstream from the present dam, which will serve later as the toe of the high dam. River flow will be taken care of by cofferdams. The government has built a 30-mile connecting railroad between Odair and the site.

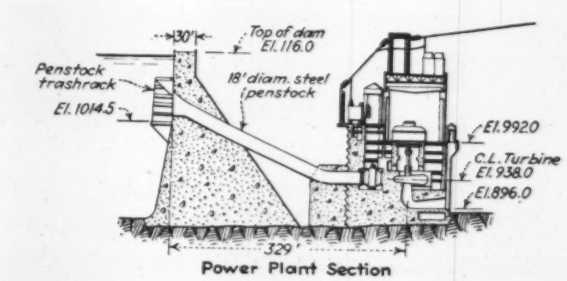
All permanent materials and equipment will be furnished by the government, including cement, delivered to the construction railroad, with separate bid items covering haulage to the dam. The contractor will furnish all aggregates from government owned pits, all forms, temporary construction materials, etc. In case the government decides to build the high dam before the present contract is finished, it reserves the right to terminate the contract, and all work done to date of termination would revert to a cost plus basis, including all labor, material and equipment costs, with 10 per cent added. All equipment on the job would be taken over on this basis, and if the total of progress estimates paid exceeded the cost plus fee amount, the contractor and sureties would be held liable for the difference.

Following is a tabulation of complete unit prices. A—Combination of Silas Mason, Inc., New York, Walsh Const. Co., Davenport and Atkinson-Kier Co., San Francisco, (contract) $29,339,302; B—Six Companies of Washington, Inc., San Francisco, $34,555,582. R. F. Walter is chief engineer of the Bureau of Reclamation, in charge of design and construction.

TYPICAL CROSS SECTIONS of non-overflow and spillway portions of Grand Coulee Dam.



Spillway Section



Power Plant Section

COMPLETE UNIT PRICES, GRAND COULEE DAM

Item and Quantity	Unit Prices A	Unit Prices B
1. River diversion—lump sum	$3 500 000	$7 000 000
2. Strip aggregate site—200,000 cu.yd.	.30	.25
3. Excavation, common—11,000,000 cu.yd.	1.00	1.10
4. Excavation, rock—800,000 cu.yd.	2.00	3.00
5. Excavation, adit tunnels—1,500 cy.yd.	8.00	15.00
6. Backfill—50,000 cu.yd.	.40	.50
7. Riprap—30,000 cu.yd.	1.00	3.00
8. Rubble masonry walls—200 cu.yd.	12.00	10.00
9. Drill B grout holes, under 30 ft.—10,000 l.f.	.75	1.20
10. Successive drilling B grout holes, under 30 ft.—8,000 l.f.	1.00	1.70
11. Drill A grout holes, 30 to 50 ft.—27,000 l.f.	2.00	1.80
12. Drill A grout holes, 50 to 100 ft.—15,000 l.f.	2.00	2.50
13. Drill A grout holes, 100 to 150 ft.—1,000 l.f.	2.00	3.00
14. Drill A grout holes, 150 to 500 ft.—1,000 l.f.	2.00	5.00
15. Drill drainage holes, under 25 ft.—500 l.f.	2.50	2.00
16. Drill drainage holes, 25 to 50 ft.—18,000 l.f.	2.50	2.50
17. Drill drainage holes, 50 to 100 ft.—500 l.f.	2.50	3.00
18. Drill drainage holes, 100 to 150 ft.—600 l.f.	2.50	5.00
19. Drill and grout anchor bars—1,000 l.f.	1.00	1.00
20. Low pressure grouting—14,000 cu.ft.	1.00	1.00
21. High pressure grouting—25,000 cu.ft.	1.00	1.50
22. Make and place porous drain tile—50,000 l.f.	.50	.85
23. Make and place porous drain tile, split units—17,000 l.f.	.75	.70
24. Concrete in dam—3,100,000 cu.yd.	3.00	3.40
25. Concrete in parapets—600 cu.yd.	15.00	15.00
26. Concrete in training walls—700 cu.yd.	10.00	12.00
27. Concrete in trashracks—34,000 cu.yd.	10.00	15.00
28. Concrete in spillway buckets, permanent cofferdams, penstock anchors and gravity walls—400,000 cu.yd.	4.50	3.80
29. Concrete in adit tunnel lining—515 cu.yd.	15.00	15.00
30. Concrete in power house below turbine floor—30,000 cu.yd.	7.00	10.00
31. Concrete in power house above turbine floor—33,000 cu.yd.	10.00	18.00
32. Special finishing concrete surfaces—16,600 sq.yd.	.60	.50
33. Place reinforcing bars—25,000,000 tons	.01	.015
34. Insulating reinforcing bars—25,000 intersections	.05	.10
35. Instal metal contraction joints—115,000 l.f.	.25	.45
36. Instal metal seals in power house below high tail water level—10,000 l.f.	.50	.60
37. Instal same above high tail water level—620 l.f.	1.00	1.00
38. Instal cork expansion joints—52,000 l.f.	.05	.10
39. Instal high pressure gates and conduit linings—6,232,000 lb.	.01	.013
40. Instal gate controls—45,000 lb.	.05	.05
41. Instal bulkhead gates—1,000,000 lb.	.01	.013
42. Instal power penstocks—8,710,000 lb.	.01	.02
43. Instal butterfly valves and controls—2,522,000 lb.	.01	.013
44. Instal traveling and gantry cranes—2,300,000 lb.	.01	.01
45. Instal track rails—203,000 lb.	.01	.02
46. Instal metal trashracks—4,242,000 lb.	.01	.01
47. Instal structural steel in power house—1,600,000 lb.	.01	.013
48. Instal misc. iron—1,200,000 lb.	.05	.07
49. Instal aluminum curbs and rails—7,400 lb.	.05	.15
50. Instal felt roofing with flashing—31,000 sq.ft.	.05	.12
51. Instal concrete floor topping and base—12,000 sq.yd.	.30	1.50
52. Instal colored concrete floor topping and base—3,300 sq.yd.	.40	1.75
53. Lightweight concrete in floors—100 cu.yd.	8.00	20.00
54. Metal lath and plaster walls—150 sq.yd.	2.50	1.40
55. Hollow plaster walls—1,100 sq.yd.	3.00	2.50
56. Hollow tile walls—1,800 sq.yd.	2.50	1.40
57. Temporary end walls—1,500 sq.yd.	2.00	1.20
58. Suspended ceilings—770 sq.yd.	2.50	2.50
59. Painting concrete walls—2,000 sq.yd.	.20	.60
60. Instal metal stairways—52,000 lb.	.05	.63
61. Instal floor plates and gratings—182,000 lb.	.02	.015
62. Instal drainage pump and fittings—15,000 lb.	.04	.03
63. Instal metal rolling doors—1,670 sq.ft.	.20	.50
64. Instal metal swinging doors—2,100 sq.ft.	.20	.50
65. Instal metal sash windows—3,600 sq.ft.	.25	.20
66. Instal window operators—1,000 sq.ft. windows	.25	.50
67. Instal sheet metal work—5,000 lb.	.25	.15
68. Instal metal partitions—400 sq.ft.	.40	.25
69. Instal misc. metal work—100,000 lb.	.05	.08
70. Instal plumbing—2,500 lb.	.25	.20
71. Install elec. conduit under 1½-in.—60,000 l.f.	.10	.15
72. Instal elec. conduit 1½ to 3-in.—75,000 l.f.	.15	.30
73. Instal elec. conduit over 3-in.—9,000 l.f.	.20	.45
74. Instal fibre conduit—750 l.f.	.25	.20
75. Instal ground wires and rods—50,000 lb.	.05	.10
76. Instal elec. cable in concrete—100,000 l.f.	.05	.05
77. Transport C/L freight over gov't RR. del. yd. to head Grand Coulee—300 cars	25.00	30.00
78. Transport LCL freight over gov't RR. del. yd. to head Grand Coulee—15,000 cwt.	.25	.15
79. Transport C/L freight over gov't. RR. del. yd. to dam—190 cars.	30.00	50.00
80. Transport LCL freight over gov't. RR. del yd. to dam—10,000 cwt.	.25	.20
81. Transport freight head of Grand Coulee to power house—8,000 tons	2.00	5.00
82. Transport freight gov't. warehouse at dam to power-house—3,000 tons	2.00	3.50
83. Sale of plant to gov't. at end of job (aggregate cement and mixing equipment)	100,000	100,00
84. Sale of camp to gov't.	75,000	100,00
85. Sale of transmission lines and substations to gov't.	25,000	100,00
Total Bid	$29,339,302	$34,555,582

Mechanical Filter Plant, Reading, Pa.

FOUR CONTRACTS, forming part of the new Maiden Creek water supply system, described in *ENR*, Sept. 13, 1934, were awarded, two on April 11, 1934, and two on May 23, 1934, for the construction of a new mechanical filter plant at Reading, Pa.: I—General building construction; II—Mechanical filter plant; III—Pumps and compressors; IV—Boilers and stokers. The building construction consists of head and filter houses of reinforced concrete, field stone exteriors with limestone trim, and peaked slate roofs. The excavation, completed under previous contract, extends respectively 19 and 29 ft. below grade. The head house is 123x68 ft., the filter house, 101x112 ft. The former building is approximately 40 ft. from grade to roof cornice, the latter, 23 ft. from grade to the clerstory cornice.

Total bids ranged as follows: I—six bidders, $442,785 to $549,599; II—four bidders, $92,180 to $214,000; III—six bidders submitting complete bids, $22,675 to $26,466; IV—four bidders, $9,100 to $10,300. The complete unit prices of the three lowest bidders for each of the four contracts follow.

CONTRACTORS AND TOTAL BIDS

I—General building construction	
A—Wm. Steele & Sons Co., Bank, Philadelphia (contract)	$442,785.00
B—Wallin Concrete Corp., Philadelphia	456,701.00
C—Turner Construction Co., Philadelphia	470,887.00
II—Mechanical filter equipment	
D—Roberts Filter Mfg. Co., Darby, Pa. (contract)	$192,180.00
E—E. W. Bacharach & Co., Kansas City, Mo.	209,990.00
F—Pitt Construction Co., Pittsburgh	213,350.00
III—Pumps and compressors	
G—Dravo-Doyle Co., Pittsburgh (contract)	$22,675.00
H—Wertz Engineering Co., Reading, Pa.	23,810.00
J—Reading Engineering Works, Reading	23,922.00
IV—Boilers and stokers (lump bids) (Furnishing and installing two steam boilers and two chain grate stokers, with complete accessories)	
1—Corbitt Bros. & S. E. Fritz Co., Reading, Pa. (contract) (based on National boilers & Hazleton stokers—3,672,000 B.T.U. normal output)	$9,100.00
2—Wertz Engineering Co., Reading, Pa. (Based on Ames boiler & Hazelton stoker)	9,630.00
3—Reading Engineering Co., Reading, Pa.	9,890.00

UNIT PRICES ON CONTRACTS I, II & III

Item	Quantities	Bidder and Unit Prices—A	B	C
I—General Building Construction				
1.	Earth excavation, 300 cu. yds.	$1.12	$0.75	$1.70
2.	Rock excavation, 600 cu. yds.	4.80	5.00	4.50
3.	Pumping, ditching, sheeting, (lump sum)	425.00	250.00	220.00
4.	Plain embankment, 1,000 cu. yds.	0.35	0.60	0.45
5.	Rolled embankment, 18,000 cu. yds.	0.38	0.425	0.63
6.	Placing top soil, 1,250 cu. yds.	1.06	0.35	0.63
7.	Screened gravel, stone fill, 125 cu. yds.	2.92	2.90	3.60
8.	Bituminous macadam paving 550 sq. yds.	1.60	3.00	2.82
9.	Concrete refill, 1,500 cu. yds.	9.20	9.30	10.00
10.	Concrete substructures, 11,000 cu. yds.	14.50	12.85	14.40
11.	Concrete superstructures, 2,000 cu. yds.	18.06	22.15	20.00
12.	Add'l. forms, substructure, 5,000 sq. ft.	0.138	0.18	0.25
13.	Steel reinforcement, 2 550,000 lbs.	0.0339	0.037	0.0387
14.	Granolithic walk, frost bed, 600 sq. yds.	2.39	2.40	2.85
15.	Monolithic hardened c'm't. finish, 19,200 sq. ft.	0.06	0.08	0.042
16.	2" cement floor finish, hardened, colored, scored, 4,910 sq. ft.	0.192	0.265	0.19
17	2" c'm't. finish as No. 16, not scored, 1,510 s. f.	0.16	0.225	0.17
18.	Granolithic finish, without frost bed, 6,450 sq. ft.	0.093	0.095	0.10
19.	Cement wall base, plain, 1,300 lin. ft.	0.33	0.185	0.30
20.	C'm't. wall base, hardened, 7 colored, 300 lin. ft.	0.40	0.235	0.40
21.	Terrazzo floors & Base in headhouse (lump sum)	2,226.00	2,650.00	2,470.00
22.	Terrazzo floors & Base in filter house (lump sum)	1,484.00	1,800.00	1,340.00
23.	Precast c'm't. treads & platforms (lump sum)	100.00	300.00	110.00
24.	Preformed exp. joint, 1" thick, 350 sq. ft.	0.27	0.30	0.46
25.	Preformed exp. joint, ½" thick, 840 sq. ft.	0.28	0.205	0.34
26.	Copper flashings, const. jts. in concrete, 15,000 lbs.	0.32	0.29	0.34
27.	Malleable iron inserts, 5,000	0.27	0.14	0.20
28.	Steel floor gratings, (lump sum)	395.00	700.00	450.00
29.	Structural steel lintels, 13,500 lbs.	0.04	0.042	0.042
30.	Misc. steel & iron work, 62,000 lbs.	0.08	0.066	0.06
31.	C. I. manhole frames & covers (lump sum)	780.00	850.00	790.00
32.	Grilles, screens & misc. bronze (lump sum)	161.00	175.00	170.00
33.	Safety stair treads & platforms (lump sum)	435.00	725.00	310.00
34.	Metal thresholds (lump sum)	165.00	250.00	100.00
35.	Stone masonry (lump sum)	24,370.00	19,650.00	22,470.00
36.	Slate sills (lump sum)	567.00	425.00	400.00
37.	Brick & hollow masonry, headhouse (lump sum)	12,720.00	15,000.00	13,940.00
38.	Brick masonry, settling basins, (lump sum)	2,650.00	3,125.00	6,130.00
39.	Fire brick lining for chimney (lump sum)	1,060.00	1,200.00	1,110.00
40.	Flint paving tile (lump sum)	1,060.00	1,300.00	1,290.00
41.	Enamelled tile wainscot (lump sum)	6,360.00	8,300.00	6,470.00
42.	Plastering (lump sum)	7,942.00	11,100.00	8,260.00
43.	Carpentry & millwork, except stop planks & fence (lump sum)	5,830.00	6,600.00	6,210.00
44.	Metal doors & trim, fixed sash & metal partitions (lump sum)	5,240.00	8,700.00	7,160.00
45.	D. H. spring balance metal windows, incl'd'g. screens (lump sum)	13,558.00	15,450.00	13,940.00
46.	Projected metal sash, incl'd'g. operators & screens (lump sum).	1,650.00	1,875.00	1,500.00
47.	Screen doors (lump sum)	48.00	50.00	60.00
48.	Weatherstripping, ext., wood doors (lump sum)	32.00	35.00	40.00
49.	Hardware applied to wood doors (lump sum)	43.00	75.00	60.00
50.	Architectural slate roof & flashings (lump sum)	5,000.00	6,350.00	5,310.00
51.	Built up flat roof, incl'd'g. flashing (lump sum)	2,490.00	2,850.00	2,640.00
52.	Sheet metal work (lump sum)	885.00	975.00	940.00
53.	Orn. ironwork for head house (lump sum)	820.00	825.00	760.00
54.	Orn. ironwork for filter bldg. (lump sum)	810.00	875.00	810.00
55.	Wrought iron pipe railings, 350 lin. ft.	1.66	1.75	1.63
56.	Electric freight elevator (lump sum)	3,780.00	4,600.00	4,010.00
57.	Wood pale fence (lump sum)	1,215.00	1,550.00	1,560.00
58.	Glass & glazing " "	1,430.00	1,625.00	1,210.00
59.	Painting " "	5,645.00	6,600.00	6,300.00
60.	Lightning conductors (lump sum)	500.00	575.00	410.00
61.	Stop planks (lump sum)	2,635.00	2,500.00	2,890.00
62.	Storm water drainage system (lump sum)	626.00	900.00	540.00
63.	Sanitary sewers, manholes, sewage treatment plant (lump sum)	544.00	850.00	250.00
64.	Bronze inscription tablet (lump sum)	90.00	125.00	110.00
II—Mechanical Filter Equipment		D	E	F
1.	Water piping & valves, 6" and over	$99,160.00	$107,400.00	$95,000.00
2.	Water piping & valves, under 6"	5,500.00	5,800.00	6,500.00
3.	Air piping and valves	1,200.00	1,400.00	3,200.00
4.	Chemical piping & valves	14,430.00	15,400.00	16,300.00
5.	Wash water controller, register, recorder, complete	5,800.00	5,900.00	5,300.00
6.	One sampling device, complete.	970.00	1,100.00	800.00
7.	One gauge, complete	2,080.00	2,400.00	2,800.00
8.	Equipment for 3 chemical dissolving tanks, complete	870.00	1,200.00	600.00
9.	Installing Venturi meter & 2 chemical feed devices, complete.	490.00	470.00	500.00
10.	One control valve complete with all control piping	1,020.00	3,800.00	4,300.00
11.	Filter underdrain system, complete	13,800.00	15,300.00	15,000.00
12.	Filter gravel, complete	6,700.00	7,200.00	6,200.00
13.	Filter sand, complete	3,500.00	3,600.00	5,200.00
14.	Water wash troughs, complete	3,000.00	3,400.00	2,300.00
15.	Six filter operating tables, complete	2,840.00	2,600.00	3,000.00
16.	Six floc detectors, complete	1,030.00	1,500.00	1,400.00
17.	Aerators, complete	7,960.00	8,000.00	23,000.00
18.	Two sludge pumps, complete	3,240.00	3,300.00	3,400.00
19.	One sump pump, complete	120.00	120.00	150.00
20.	One mechanical screen, complete	3,250.00	3,700.00	3,800.00
21.	Two dry feed machines for lime, incl d g slakers & control apparatus	5,840.00	7,100.00	6,300.00
22.	Two dry feed machines for activated carbon	920.00	1,100.00	800.00
23	Two chlorinators complete, with control apparatus	5,600.00	5,200.00	4,800.00
24.	Two ammoniators, complete, with control apparatus	1,700.00	1,700.00	1,500.00
25.	Two scales, complete	1,160.00	1,300.00	1,000.00
III—Pumps and Compressors		G	H	J
1.	One 15 M.G.D. centrifugal pump	$5,180.00	$4,056.00	$4,493.00
2.	One 10 " " "	2,600.00	2,601.00	2,726.00
3.	One 5 " " "	1,370.00	1,769.00	1,346.00
4.	One 3 " " "	1,070.00	1,446.00	995.00
5.	One 200 G.P.M. " "	390.00	374.00	335.00
6.	One 100 G.P.M. centrifugal sump pump	500.00	520.00	521.00
7.	One 40 G.P.M. centrifugal pump	170.00	192.00	192.00
8.	Two 98 C.F.M. vacuum pumps, each	540.00	618.00	598.00
9.	Three 150 C.F.M. air compressors, each	663.00	707.00	706.00
10.	Tanks and compressors (lump sum)	730.00	900.00	840.00
11.	Electrical equipment (lump sum)	7,595.00	8,594.00	9,160.00

CONSTRUCTION REPORTS

WATERWORKS

PROPOSED WORK

Calif., San Diego—City election Nov. 6, $350,000 bonds, to be used with other funds to construct pipe line from El Capitan Dam to lakeside; also election Nov. 6, $96,000, repairing and strengthening Hodges Dam.

Colo., Colorado Spring—City soon takes bids earth fill dam for augmenting water system. Est. about $300,000. F. O. Ray, city engr. Noted Aug. 16.

Colo., Colorado Springs — City, E. Mosley, mgr., plans sewage disposal plant, $198,389. Project to be voted on by taxpayers in spring. Noted July 5.

Ill., Charleston—Bd. P. Impvts., City Hall, made plans improving waterworks, new wells, filter beds, settling beds, etc., $100,000. Referendum vote Nov. 6. C. DeLeuw & Co., 20 North Wacker Dr., Chicago, engrs. Noted July 19.

Ill., Evanston—Bd. Local Impvts., preliminary plans completed 1 m.g. water storage tank and 16 in. or larger watermains, $250,000. Election Nov. 6 to vote on bonds for same. Alvord, Burdick & Howson, 20 North Wacker Dr., Chicago, engrs.

Ill., Golconda—City tentatively awarded contracts crib intake pipe line, Item 1, to J. Wardrop & Son, Golconda, $33,500; water distribution system, mains, etc., Item 2, to Ostrom Realty & Constr. Co., Peoples Bank Bldg., Indianapolis, Ind., $23,500. James Anderson Co., 200 Deerpath Rd., Lake Forest, engrs.

Ind., East Gary—City plans water supply. P.W.A. project.

La., Port Allen—City plans waterworks, $21,000, and community center, incl. swimming pool, $39,000. P.W.A. loans and grants approved. L. J. Voorhies, Baton Rouge, engr. Noted May 17.

Mass., Newburyport—City plans reservoir improvements and repairs also storage building unit.

Minn., Kimball Prairie—Village, W. T. McIver, clk., soon takes new bids waterworks system, $24,000. Former bids rejected. P.W.A. project. M. B. Lang, St. Cloud, engr.

Mo., Bland—City soon takes bids waterworks and distribution system, $44,500; sanitary sewerage system, $25,500. G. E. Wells, Inc., 420 Security Bldg., St. Louis, engrs. Noted July 26.

Mo., Walnut Grove—City defeated bonds constructing waterworks system, $29,000. Ozarks Eng. Co., Court House, Springfield, engrs. Noted Mar. 22.

N. H., Hinsdale—Town, A. Krumenaker, chn. Water Supply & Sewerage Bd., preliminary plans reservoir at Kilburn Rd. Metcalf & Eddy, 1300 Statler Bldg., Boston, Mass., engrs.

N. J., Woodbury—Municipality plans electrifying water pumping station, $50,000. P.W.A. funds allotted. F. F. Kaufman, 909 Pine St., Camden, engr. Noted Jan. 11.

N. Y., Avoca—Village, J. W. Kennedy, mayor, plans water supply system addition, incl. laying pipe line from springs on property recently required to village reservoir.

N. Y., Babylon—Town Bd. received petition from group of citizens headed by W. A. Jennings, for water plant for Oak Island Beach.

N. Y., Wellsville—Municipality, waterworks project and power plant. **Maturity indefinite.** $85,000. P.W.A. allotment rescinded. E. J. Rowe, 110 Maple St., engr.

O., Bradner—City plans waterworks system, $48,000 P.W.A. loan and grant approved. George Champe & Associates, Nicholas Bldg., Toledo, engrs. Noted May 17.

O., Conneaut—City plans 12 in. c.i. watermain in Lake Rd., $10,360; landscaping Lake View Park, $8,518; grading, widening, surfacing Jackson St., $4,125; sanitary sewers in 3 streets, $12,000; storm sewer in Buffalo St., $8,720; leveling repair sidewalks, $5,200; other miscellaneous work to bring total cost to $148,557. F.E.R.A. projects. Applications for funds made.

O., Doylestown—Village plans waterworks system, $54,000 P.W.A. loan and grant approved. G. B. Gascoigne, 1140 Leader Bldg., Cleveland, engr. Noted Aug. 24, 1933.

O., Fayette—City plans waterworks, $60,000 P.W.A. loan and grant approved. George Champe & Associates, Nicholas Bldg., Toledo, engrs. Noted Apr. 19.

O., Lynchburg—Village plans waterworks system, $20,000 loan and grant approved. Jennings-Lawrence Co., 12 North 3rd St., Columbus, engrs. Noted Sept. 7, 1933.

O., Seaman—City plans waterworks system, $41,000 loan and grant approved. W. S. Heer Eng. Co., Portsmouth, O., and Terre Haute, Ind., engrs. Noted Apr. 26.

O., Smithfield—City plans waterworks system, $60,000 loan and grant approved. Harrop-Hopkins & Taylor, 801 Grogan Bldg., Pittsburgh, Pa., engrs. Noted May 10.

O., Upper Arlington (Columbus P. O.)—Village Comm. abandoned plans for waterworks, $140,000. Project was approved but owing to water contract made with Columbus, project was abandoned. Burgess & Niple, 368 East Broad St., Columbus, engrs. Noted Apr. 12.

O., Wooster—City plans application for P.W.A. loan to finance construction water softening and iron removal plant, $74,000. Barstow & Lefeber, 31 North Summit St., Akron, engrs. Noted Aug. 30.

Tenn., Camden—City plans ready for P.W.A. approval for 1 deep well pump, 1 concrete pumphouse, complete distribution system, one 100,000 gal. elevated tank, using 2- to 10-in. c.i. pipe. Est. $42,000. J. A. Switzer, Engineering Bldg., Knoxville, engr. Noted Aug. 9.

Tex., Brownwood—City, c/o W. H. Thompson, mayor, plans waterworks improvement, $31,000. P.W.A. loan and grant not negotiated by owner due to technicalities. M. E. Razsdale, Brownwood, engr. Noted July 12.

Tex., Handley—Tarrant Co. Water Control & Impvt. Dist. 2, c/o W. C. Foster, Handley, complete water system with well, elevated tank, pumping equipment, fire hydrants, distribution system, $135,000. P.W.A. loan and grant allotment approved. Hawley, Freese & Nichols, Capps Bldg., Fort Worth, engrs. Noted Jan. 11.

Tex., Sweetwater—City, c/o S. H. Bothwell, mgr., soon takes bids waterworks improvements, incl. pumping station, pipe lines, $160,000. P.W.A. project. Bonds voted for same; Hawley, Freese & Nichols, Capps Bldg., Fort Worth, engrs. Noted Aug. 16.

Ont., Exeter—Exeter Pub. Utilities Bd. making plans water system. D. H. Fleming, engr.

Ont., Kitchener — Council plans expending $75,000 for program of winter work of waterworks and sewer extensions, etc. S. Shupe, city engr. will prepare a report.

Ont., Port Colborne—Town soon takes bids constructing new 2 ft. intake pipe, $70,000. C. A. Grassie, town engr. Noted Sept. 27.

Que., Grand Mere—See "Sewerage and Waste Disposal."

BIDS ASKED

Colo., Montrose—City bids about Oct. 15, 2 m.g.d.c. rapid sand filter plant. B. Lowther, Colorado Bldg., Danver, engr. Noted Mar. 1.

Ill., Saybrook—Oct. 26, by Village, 16,200 ft. 4- to 8-in. c.i. pipe, 2,000 ft. 2 in. galvanized pipe, 40 fire hydrants, one 60,000 gal. tank on tower, 100 services and meters, one 14x14 ft. brick pump house, one 10 in. well, 60 ft. deep, 1 motor driven turbine-type 100 g.p.m. pump, $52,000. P.W.A. project. Kinsey Eng. Co., 515 Court St., Pekin, engrs.

Mass., Northboro—Town taking bids constructing filter beds, reservoir, pumping station and standpipe for water system. To exceed $25,000. Weston & Sampson, 14 Beacon St., Boston, engrs. Noted Aug. 16.

Mass., Weymouth — Oct. 22, by Town, Bd. Water Comrs., constructing water filtration plant, incl. excavation and structures, complete pumping plant, filter equipment and piping. P.W.A. project. Noted Aug. 2.

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Federal Government projects are classified under heading denoting type of work and designated by symbol of †

◆

La., New Orleans—Nov. 30, by Sewerage & Water Bd., 526 Carondelet St., A. G. Moffat, secy., furnishing labor and material on percentage basis for waterworks, sewerage and drainage construction during year 1935. B. Vallas, genl. supt.

Mich., Detroit—Oct. 25, by L. G. Leonhardt, comr. P. Wks., furnishing, delivering installing vertical electric motor driven pumping unit having 500 gal. per second capacity at 27 ft. head of elevation, together with auxiliary equipment, in Connors Creek Storm Water Pumping Station, Jefferson and Clairpointe Aves.

N. Y., Bethlehem—Oct. 15, by Water Comrs. Dist. 1, W. D. Jordan, chn., 15,500 ft. 10 in. c.i. supply main, storage reservoir, excavation, rolled embankment, rip rap and outlet works, water softening plant, auxiliary piping, pumping equipment, brick building for housing same, etc. P.W.A. project. Solomon & Kets, 257 Bway., Troy, consult. engrs.

N. Y., Stillwater—Oct. 18, by Bd. Village Trustees, Fire Hall, 20,600 ft. 6 and 8 in. c.i. watermains equipped with valves and hydrants, 2 wells, pumping station equipped with 2 deep well pumps, aerator, iron removal plant, 200,000 gal. steel tank, 50 small mains for house services. Solomon & Kets, 257 Bway., Troy, consult. engrs.

Tex., McKinney—Oct. 22, by City, c/o J. E. Sargent, mayor, waterworks improvement, incl. drilling deep water well, new pumphouse, new pumping equipment, extending watermains, wire cable guard fence, etc., $55,000. P.W.A. project. Koch & Fowler, 801 Central Bank Bldg., Dallas, engrs. Noted July 12.

Tex., Richland Springs—Oct. 19, by City, c/o City Secretary, constructing complete waterworks, incl. new wells, pumping equipment, supply mains and distribution system, $30,000; furnishing, erecting one 50,000 gal. elevated steel tank. J. S. Ross, San Saba, engr. W. J. Powell, Republic Bank Bldg., Dallas, consult. engr. Noted Sept. 6.

CONTRACTS AWARDED

Ariz., Phoenix—City, furnishing, installing 67,387 lin.ft. 2- to 24-in. c.i. pipe, valves and fittings, to Arizona Concrete Co., 1724 Grand Ave., $97,242. **P.W.A.** Bids Sept. 4.

Ark, Mt. Ida — Town, F. Edwards, mayor, well, system of 2, 4 and 6 in. c.i. mains, c.i. specials, tank on tower, pumphouse, booster pumps, etc., to E. T. Luke Co., Fort Smith, $25,268. **P.W.A.** Bids July 5, awarded Sept. 21. Noted June 28.

Ind., Michigan City—Bd. P. Wks., pumping equipment for filter plant, Div. D, to American Well Wks., Aurora, Ill., $11,322. **P.W.A.** Bids Aug. 30. Noted Aug. 15.

Kan., Sedan—City constructing 3½ mi. 8 in. pipe, filtration plant complete, incl. motor driven pumps, etc., to Carrothers & Crouch.

†*Federal Government.*

For official proposal advertising see Searchlight Section

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Waterworks (Continued)

B.M.A. Bldg., Kansas City, Mo., $75,597. Est. $70,000. **P.W.A.** Bids Sept. 14. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., engrs. Noted July 26.

Mich., Grayling—O. G. Clippert, village pres., Crawford Co. Court House, constructing waterworks system, wells, to A. Funck, Grayling, $510***pumphouses, to H. Walthers, Roscommon, $2,160***elevated storage tank, to Chicago Bridge & Iron Wks., 1313 Lafayette Bldg., Detroit, $7,920***c.i. water pipe, to Jas. B. Clow & Sons, 3284 Leslie Ave., Detroit, $13,918 ***gate valves and hydrants, also service connections, to Traverse City Iron Wks., Traverse City, $1,990 and $1,765 respectively. Grand total $28,263. **P.W.A.** Noted Aug. 5.

Neb., Lexington—City, to National Cast Iron Pipe Co., Land Bank Bldg., Kansas City, Mo., 2- to 8-in. open bell c.i. pipe specials for waterworks, $24,344***to Florence Pipe Fdry. & Machine Co., Phila., Pa., valves and valve boxes, $836***to W. C. Jones, Lexington, installing 2- to 8-in. pipe, $13,882; relocating and installing old fire hydrants and old service connections, $1,635; installing valves and boxes and manhole construction, $558***to F. H. Jacobson & Son, Lexington, Sect. 6 complete, $1,429; 2 Fairbanks-Morse pumps, $1,500; removing and laying 2 and 4 in. pipe, $2,866. Grand total $47,050. **P.W.A.** Noted Jan. 25.

Neb., Nehawka—City, waterworks, to Charles Robeck Co., 1132 South 32nd St., Omaha, $19,820. **P.W.A.** Awarded Sept. 25. Noted Feb. 8.

N. H., Claremont—Town, constructing reservoir, $50,000. Owner builds. Superintendent Waterworks in charge of construction.

New York—Bd. Water Supply, 346 Bway., New York, furnishing, testing, delivering electric cables, conductors and appurtenances for gate valve and drainage chambers and furnishing delivering, operating and indicating apparatus for section and needle valves in Shaft 9A, City Tunnel 2, Contr. 255, to A. J. Ulmer, 90 West Bway., New York, $25,133. **P.W.A.** Bids Sept. 18. Noted Aug. 30.

Tex., Sudan—City tentatively awarded contract for waterworks, incl. 100,000 gal. concrete underground reservoir, concrete pumphouse, booster pump, drilling casing and equipment for 2 wells, tieing in 5 wells, 6 in. c.i. pipe suction line from booster pump, to Smith & McGlamery, Amarillo, c/o H. Banks Jones, engr., Amarillo, $56,290. **P.W.A.** Bids Sept. 10.

W. Va., Kermit—Town waterworks and sewage disposal system, to E. R. Mills, Charleston, $52,110. **P.W.A.** Bids Sept. 5.

Wis., Frederic—Village, watermains, pipe hydrants, valves, to J. B. Clow & Sons, 201 North Talman Ave., Chicago, Ill., $6,586; laying pipe, to Orfei & Marion, St. Paul, Minn., $5,972. P.W.A. Bids Sept. 21.

SEWERAGE AND WASTE DISPOSAL

PROPOSED WORK

Ark., Brinkley—City indefinitely delayed taking of bids for extensions to sewerage system and new diesel plant, $41,000. P.W.A. loan and grant.

Calif., Petaluma—City, election about Dec. 11, $195,000 chemical treatment plant for sewage disposal. J. B. Piatt, Roseberg Bldg., Santa Rosa, engr. Noted Sept. 13.

Calif., San Mateo—City election about Nov. 6, $85,000, sewers and sewage disposal plant. Burlingame and Hillsboro will assist in financing and have funds available for the purpose. Noted Sept. 13.

Conn., Fairfield—Town, R. Garrabrants, chn. Garbage Disposal Comn., plans incinerator, $30,000; collection trucks approved bodies, garage, etc. Est. $50,000.

Conn., West Hartford (br. Hartford)—Town, F. Chamberlain, Town Hall, bids in November, constructing 4,000 ft. interceptor sewer, $140,000. F. Chamberlain, Town Hall, West Hartford, engr. Noted Aug. 23.

Ill., Bloom Twp.—Bloom Twp. Sanitary Dist., preliminary plans completed intercepting sewers and disposal plant. Ashdowne & Williams, 1530 Halsted St., Chicago Heights, and Greeley & Hanson, 620 North Michigan Ave., Chicago, engrs. P. W. A. project.

Ill., Edwardsville—City bids late in October or in November, sewage treatment plant, incl. auxiliary piping $75,000, 6- to 27-in. vitr. or

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concrete and 10- to 24-in. c.i. intercepting sewers and appurtenances, $105,000. P.W.A. project. W. H. Morgan, city engr. Sheppard, Morgan & Schwaab, Alton and Edwardsville, consult. engrs. Noted Sept. 6.

Ind., Michigan City—Making plans sewage disposal plant, $338,000. P.W.A. project. C. Hurd, 1039 Architects Bldg., engr. City officials signed contract with engineer for plans and make arrangements for bond issue. Noted Nov. 2.

Mo., Bland—See "Waterworks."

Mo., St. Clair—City election Oct. 23, $33,000 bonds, complete sewage disposal plant, equipment, auxiliary piping and sanitary sewers, $45,000. $12,000 grant and $33,000 loan allotted by P.W.A. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, engrs. Noted Sept. 13.

Mont., Hamilton—City, defeated $65,000, constructing sewage disposal plant. W. T. Pierce, Hamilton, engr. Noted Sept. 13.

Neb., Callaway—Village made plans sanitary sewerage system and sewage disposal plant. P.W.A. allotment approved. Nixon & Reynolds, Grain Exch. Bldg., Omaha, engrs. Noted Feb. 1.

N. J., Little Falls Twp. — Township plans storm drainage and paving, $33,000 allotted by P.W.A. P. S. Boughtman, Cedar Grove, engr.

N. Y., Alden—Municipality plans sewers and sewage disposal plant, $91,000. A. G. Leopold, 15 Lombardy St., engrs. P.W.A. funds allotted.

N. Y., Elmira—Municipality defeated proposal to construct sewers, $488,000. P.W.A. allotment rescinded. Project indefinitely postponed. G. P. Hevenor, 245 Melrose St., Rochester, engr. Noted Aug. 16.

N. Y., Jamestown—City making plans storm sewerage system in vicinity Fluanna Ave., 22nd and Washington Sts. To exceed $25,000. L. F. Graham, city engr.

N. Y., Riverhead—Town Bd. plans sewerage system. $350,000. 51 per cent of taxpayers petitioned board for improvement. Federal aid for project has been proposed.

N. C., Belmont—Town filed application with P.W.A. for loan to finance construction sewers, Gaston Co., $50,000.

O., Conneaut—See "Waterworks."

O., East Palestine—City plans disposal plant. Council on Sept. 17 voted to bring in an outside engineer to study local situation, see whether new plant necessary.

Tex., Pilot Point—City, c/o J. L. Noel, mayor, plans sanitary sewerage system, incl. rein.-con. disposal plant, Imhaff tanks, etc. $46,000. P.W.A. loan and grant allotment approved. Hawley, Freese & Nichols, Capps Bldg., Fort Worth, engrs. Noted July 27.

Tex., Stratford—City, A. Ross, mayor, rejected bids sanitary sewerage system, $70,000. Plans abandoned. W. D. Howren, 800 Florida St., Amarillo, engr. Noted Sept. 20.

Va., Falls Church—Town Council plans sewerage system, $177,000. P.W.A. project. J. N. Chester Engineers, Clark Bldg., Pittsburgh, Pa., engrs.

Wis., Adams — City plans sewage disposal plant, $65,000. P.W.A. project. R. Cramer & Son, 647 West Virginia St., Milwaukee, engrs. Noted Jan. 4.

Wis., Milwaukee — Dpt. P. Wks., City Hall, making plans 2 coagulation basins and 2 filter water reservoirs, rein.-con. P.W.A. project. Alvord, Burdick & Howson, 20 North Wacker Dr., Chicago, Ill., engrs.

Wis., South Milwaukee—City defeated bonds for sewage disposal plant and collecting sewer, P.W.A. project. Consoer, Townsend, Older & Quinlan, 205 West Wacker Dr., Chicago, Ill., engrs. Noted July 19.

Ont., Kitchener—See "Waterworks."

Ont., London—Council plans extending Knollwood Park Sewer, $71,000; Victoria St. Interceptor Sewer, $72,000, in connection with winter relief projects. W. Veitch, city engr. will prepare reports.

Ont., Ottawa—City making plans new storm sewers in Lloyd, Wellington, Booth and Elm Sts., $161,070; Elm, Preston and Champagne Sts., $79,900; Lyon, McLeod and Brouson Sts., $86,990. F. C. Askwith, Ottawa, engr.

Que., Grand Mere—Town plans sewers and watermains, $50,000.

Que., Montreal—City plans sanitation plant to prevent pollution of Back River, $750,000; also erecting sewage pumping station, $1,250,000. I. E. Blanchard, dir. P. Wks.

BIDS ASKED

Ill., Monmouth—Nov. 5, by City, E. McKinnon, mayor, sewage disposal plant, $157,0 P.W.A. project. Kinsey Eng. Co., Pekin, en

La., New Orleans—See "Waterworks."

Mass., Boston—Oct. 15, by Dpt. P. Wks., C. J. Carven, comr., City Hall Annex, conc or vitr. clay sewer lines in Beaver Pl. fr embankment Rd. to Beaver St. To exceed $2 000. P.W.A. project.

Mass., North Adams—Oct. 22, by Comm Wks., J. P. Miller, comr., constructing sewer system in Blackinton Dist. P.W.A. proj Metcalf & Eddy, 1300 Statler Bldg., Bost engrs.

N. Y., Long Island City—Oct. 16, by J. Halleran, acting pres. Queens Boro, Queens Sq way Bldg., sewers in Mathewson Court, 17 Pl., Juniper Valley, 110th and 114th Rd 63rd, Fowler, 108th, 107th and Westchest Aves., 69th, 172nd, 178th, 188th, 193rd, 199 176th and 178th Sts.

Pa., Wilkes Barre—Oct. 22, by City, Cou 1, sanitary sewer for Basins 8 and 9, surfa drain for 12th and 15th Wards. W. P. John Bu. of Eng., city engr. Noted Oct. 26, 193

Tex., Dallas—Oct. 24 (extended date), b City, c/o O. H. Koch, dir. P. Wks., storm sew Dist. 19, from White Rock Creek to Marbur St. Est. $35,000. P.W.A. project. J. B. Winde City Hall, engr.

CONTRACTS AWARDED

Kan., McPherson—City, 10 and 12 in. sewe lines, to J. O'Neel Constr. Co., Leavenworth $27,900. **P.W.A.** Noted Sept. 27.

Minn., Lakeville—Village, constructing sanitary sewerage system and treatment plant, t Starbuck Constr. Co., Starbuck, $15,687; plant to Arlington Cement Stone Wks., Arlington $17,544. **P.W.A.** Bids Sept. 24. Noted Sept 13.

N. Y., Great Neck—Village, constructing sewage treatment plant, structures and sewers t Pairier & McLane Corp., 33 West 42nd St New York, $607,000. Contractors now takin bids on mechanical equipment. **P.W.A.** Bids Aug. 11. Noted Aug. 9.

O., Cincinnati—Hamilton Co., Muddy Creek Sanitary Sewer No. 46, Schedule "C", involving 7,434 ft. 30 in. rein.-con. and 2,317 ft. 24 in vitr. clay sanitary sewers, Contr. 46, Schedul "C", to O'Connell & Sweeney, Kellogg and Tennyson St., $74,826. Est. $88,000. **P.W.A.**

R. I., Providence—City, Water & Sewer Dpt City Hall, furnishing, installing diffuser plates in sewage disposal plant, Contr. 1, to Carborundum Co., 321 Summer St., South Boston Mass., $18,640. **P.W.A.** Bids Aug. 27.

S. C., Rock Hill—City, T. C. Marshall, mgr., sewer outfall system from Rock Hill to point in Catawba River between Charlotte and Rock Hill, pumping station, to Blythe Bros., Inc., 42 South Brevard St., Charlotte, N. C., $226,07 **P.W.A.** Bids Sept. 27. Noted Sept. 20.

Wash., Seattle—Bd. P. Wks., clay and precast concrete sewer in Railroad Ave., to R. Mastro, 2116 Judkins St., $18,787. Est. $22,011. Bids Sept. 24.

BRIDGES AND GRADE CROSSINGS

PROPOSED WORK

Massachusetts—Commonwealth of Massachusetts, Dpt. P. Wks., 100 Nashua St., Boston, plans rein.-con. bridge at Forest Lake, Palmer. To exceed $25,000. F. E. Lyman, comr. and A. W. Dean, ch. engr., 100 Nashua St., Boston.

N. Y., Colesville—Delaware, Lackawanna & Western R.R. Co., M. H. Doughty, ch. engr., Hoboken, N. J., making preliminary plans eliminating Depot Hill Crossing. To exceed $30,000.

N. Y., Harpersville—Delaware, Lackawanna & Western R.R. Co., M. H. Doughty, Hoboken, N. J., preliminary plans eliminating grade crossing. To exceed $25,000.

Rhode Island—State, Bd. P. Roads, Providence, making plans replacing 2 existing railroad bridges with concrete and structural steel single bridge and approaches, Narraganzett Ave. to Columbus Sq. $150,000. G. H. Henderson, State Office Bldg., Providence, engr.

Texas — State Hy. Comn., J. Wood, chn., Austin, making plans steel, concrete bridge over Double Mountain Fork of Brazos River and grading Hy. 4, N.R.S. 783, Stonewall Co. P.W.A. project. W. A. French, Abilene, div. engr.

†*Federal Government.*

Bridges, etc. (Continued)

Wis., River Hills—Village defeated bond issue constructing bridge. $35,000. P.W.A. project. C. Whitney, engr. Noted Sept. 28, 1933.

B. C., Victoria—Pacific Great Eastern Ry. preparing plans timber, steel bridge at Cheakamus. $100,000.

Man., Selkirk—Dpt. P. Wks., Ottawa, Ont., making plans 6 span 700 ft. concrete, steel bridge, 22 ft. wide over Red River. $225,000. A. J. Taunton, 930 Somerset Ave., Fort Garry, engr. Noted July 26.

Que., Levis—Dpt. Roads, Quebec City, making plans 555 ft. bridge, 49 ft. high over Three Salmons River, between Levis and Riviere du Loup. Owners having own engineer prepare plans.

BIDS ASKED

Illinois—See "Streets and Roads."

Mo., Camdenton—Oct. 16, by Camden Co., J. M. Bunch, presiding judge, constructing vehicular bridge across Osage Arm of Lake of the Ozarks, 30 mi. south of Versailles. $666,000. P.W.A. project. Sverdrup & Parcel, 1848 Railway Exch. Bldg., St. Louis, engrs. Noted July 19.

N. J., South Plainfield—Oct. 25, by Lehigh Valley R.R. Co., G. T. Hand, ch. engr., 143 Liberty St., New York, constructing steel, concrete hy. bridge for eliminating grade crossing of Park Ave., Oak Tree, South Plainfield Boro, Middlesex Co. P.W.A. project. Noted Aug. 30.

New York—See "Streets and Roads."

Ohio—Oct. 19, by O. W. Merrell, dir. Hys., Columbus, constructing 15 ft. span concrete slab bridge over Berry's Run; 25 ft. span concrete slab bridge over Wilks Run; 60 ft. span timber bridge with steel beams over Captina Creek; 63 ft. 8 in. steel girder span bridge over Long Run, together with traffic bound surface course paving 1.564 mi. hy. on Sect. "E" Barnesville-Powhatan Rd., Belmont Co., $59,644.

CONTRACTS AWARDED

Arkansas—State Hy. Comn., Little Rock, raising 150 ft. steel truss span bridge, replacing existing timber approaches with I-beam spans, over L'Anguille River, Hy. Sect. 10, Lee Co., Job 11091, to W. L. Sharpe, Memphis, Tenn., $12,869***constructing three 110 ft. low truss and two 55 ft. I-beam span bridge over Big Mulberry Creek Hy. 23, Sect. 4, Franklin Co., Job 4178, to McEachin & McEachin, Rector Bldg., Little Rock, $47,078.

Colorado—State Hy. Dpt., Denver, railroad overhead crossing and bridge with gravelled approaches on 0.698 mi. hy. near Dotsero on State Hy. 4, NRH 240-A (1935) Eagle Co., to Horner & Switzer, Arvada, $96,576. Awarded Sept. 29.

Indiana—State Hy. Comn., Indianapolis, bridge in Lake Co., to Strandberg Bros. Co., 608 South Dearborn St., Chicago, Ill., $9,632. Est. $13,618. Bids Sept. 18. Noted Sept. 13.

Iowa—State Hy. Comn., Ames, bridge in Marshall Co., to A. Emmert & Sons, Grinnell, $13,424***13 concrete pipe culverts and pony truss bridge in Ringgold Co., to Snyder & Johnson, Inc., Humboldt, $15,957***25 box culverts and extensions, on same road, to A. M. Cohron & Bro., Des Moines, $17,142***bridge on same road, to Duvall & McKinney, Logan, $24,299. Grand total $70,822. **P.W.A.** Bids Sept. 12. Noted Sept. 6.

Iowa—State Hy Comn., Ames, 1 pipe and 5 box culverts in Appanoose Co., to E. A. Kramme Co., Inc., Des Moines, $7,882***bridge and culverts, Lee Co., to Snyder & Johnson, Inc., Humboldt, $16,592***bridges, Monona Co., to Fort Dodge Constr. Co., Fort Dodge, $16,396. Grand total $40,870. **P.W.A.** Bids Sept. 25. Noted Sept. 20.

†**Massachusetts**—U. S. Eng., Boston, constructing lighting systems for 2 highway bridges over Cape Cod Canal, between Bourne and Sagamore, to Hixon Electric Co., 165 Pearl St., Boston, $27,100. Bids Sept. 6. Noted Aug. 30.

Mass., Worcester—City, E. W. Jenkins, street comr., City Hall, widening, relocating Plantation St. Bridge, to C. I. Hosmer, 87 Prospect St., Greenfield, $43,443; Foster St. Bridge, to Coleman Bros., Inc., 245 State St., Boston, $34,500. **P.W.A.** Bids Sept. 26. Noted Sept. 20.

†*Federal Government*

Nebraska and Iowa—Omaha Council Bluffs Missouri River Bridge Bd. Trustees, bridge to have two 421 ft. river spans on concrete piers, 4,000 ft. approaches over Missouri River from Omaha, Neb., to Council Bluffs, Ia., to Minneapolis Bridge Co., 701 Metropolitan Bldg., Minneapolis, Minn., $2,075,000. Plans to be changed so that total costs will not exceed $2,500,000.

New Jersey—State Hy. Comn., Trenton, constructing bridge and approaches at crossings of Central R.R. of New Jersey and completing approaches at Delaware, Lackawanna & Western R.R., at Hampton, Hunterdon Co., to Franklin Contg. Co., 20 Washington Pl., Newark, $75,410. Bids Oct. 1. Noted Sept. 27.

N. Y., East View—New York Central R.R. Co., J. W. Plau, ch. engr., 466 Lexington Ave., New York, constructing superstructure (incl. concrete work, drainage and waterproofing thereon) of bridge to carry tracks of Putnam Div. of railroad over Saw Mill River Parkway, at East View Station, to American Bridge Co., 71 Bway., New York. **P.W.A.** Noted Sept. 13.

O., Springfield—See "Earthwork, Irrigation, Drainage and Waterways."

South Dakota—State Hy. Comn., Pierre, to W. A. Barnhart Constr. Co., Salem, bridges in Lawrence Co. $14,415; Marshall Co. $3,199*** to Graves Constr. Co., Melvin, Spink Co., $9,829; Spink Co. $4,514***to W. Bonesteel, Wagner, Fall River Co. $27,928***to J. C. Sorenson, Trent, Yankton Co. $5,297***to W. H. Pringle, Pierre, guard rail in Ziebach Co. $243; Stanley Co., $3,468; Day Co. $704; Marshall Co. $1,784***to W. R. Lindekugel, Spencer, in Kingsburg Co. $470; Sanborn Co. $477; Hand Co. $281; Jerauld Co. $595; Charles Mix Co. $331***to Hermans, O'Neill & Garbey, Millbank, in Walworth Co. $350; Corson Co. $1,761***to J. R. Fitzpatrick, Kennebeck, in Jones Co. $495; Lyman Co. $3,293. Grand total $79,434. **P.W.A.** Rejected bids Sept. 6, bridge in Campbell Co.; guard rail in Jerauld and Charles Mix Counties. Bids Sept. 6.

Vermont—State Hy. Dpt., H. E. Sargent, ch. engr., Montpelier, constructing New Haven Reef Bridge, 3 span, steel I-beam, Project 163 M, Weybridge and Waltham, to Eastern State Bridge Co., Inc., Concord, N. H., $25,000. Bids Sept. 14, awarded Sept. 28.

Washington—See "Streets and Roads."

Wisconsin—State Hy. Comn., Madison, structures in Dane Co., to S. Swenson, Mount Horeb, $9,637***Tilden Mill Bridge, Chippewa Co., to R. W. Ohles, Ladysmith, $6,022***Lambs Creek Bridge, Dunn Co., to Wisconsin Bridge & Iron Co., 5023 North 35th St., Milwaukee, $39,478***Dunnville Bridge and Elk Creek Bridge, Dunn Co., to Worden-Allen Co., P. O. Box 2057, Milwaukee, $21,123 and $16,110 respectively, all foregoing **P.W.A.***structure, Dunn Co., to A. R. Coffeen, Decorah, $4,741***2 bridges in Vernon Co., to L. Schroeder, Cashton, $12,739***Weeks Bridge, St. Croix Co. to E. Blank, Cochran, $4,404. Grand total $114,254. Bids Sept. 25. Noted Sept. 13.

B. C., Victoria—See "Streets and Roads."

Ont., Toronto—Richardson Constr. Co., general contractor, 10 Adelaide St. E., sub-contract for rein.-con., steel bridge over Strathgowan Ave., Mt. Pleasant Rd., to Dominion Bridge Co. Ltd., 1139 Shaw St., for City. Noted Aug. 9, under "Contracts Awarded."

STREETS AND ROADS

BIDS ASKED

Alabama—Oct. 19, by State Hy. Dpt., Montgomery, asphalt on concrete paving 0.871 mi. streets in Tuscaloosa. $37,500.

Arizona—Oct. 18, by State Hy. Comn., Phoenix, grading, draining, asphalt seal coat surfacing in Benson, NRM 18-E and NRM 79-D, incl. 5,600 cu.yd. roadway excav.; grading, draining Ashford-Jerome Hy. Junction, NRS 19-A, 1,600 cu.yd. borrow; constructing 2 concrete bridges on Geronimo-Solomonsville Hy. NRH 67, in Solomonsville, 370 cu.yd. structural and 500 cu.yd. drainage excav. T. S. O'Connell, state hy. engr.

Calif., Beverly Hills—City Council did not receive bids Sept. 25, resurfacing parts of Olympic Blvd. and Santa Monica Blvd. $35,000. W. R. Metz, City Hall, engr.

Illinois—Oct. 19, by Dpt. P. Wks. & Buildings, Div. Hys., Springfield, concrete paving 0.25 mi. approaches to C.M. St.P. & P.R.R. overhead near Davis Junction, Route 72, Sect. 119-NRS, Ogle Co.; 0.15 mi. approaches to Chicago, Burlington & Quincy R.R. overhead, Biggsville, Route 94, Sect. 108VX NRS, Henderson Co.; grading 2.25 mi. Route S.A. 3, Sect. 6A-NRS, north and south of Inman, Gallatin Co.; 4.58 mi. S.A. 15, 3A-NRS, south of Fandon, McDonough Co.; 5.49 mi. S.A. 2A Sect. 27A NRS, McLean Co.; 7.16 mi. east side Lake Springfield, Route S.A. 5F, Sect. 30ANRS, Sangamon Co.; overhead structure near Davis Junction, Route 27, Sect. 119 VB-NRS, Ogle Co. E. Liebermann, ch. hy. engr.

Ia., Sigourney—Oct. 16, by Keokuk Co., grading 6 mi. secondary road, incl. 68,946 cu.yd. earth and 5,366 cu.yd. channel change excav. F. K. Brown, co. engr.

Kentucky—Oct. 23, by State Hy. Comn., Frankfort, grading, draining 3.23 mi. Drakesboro-Paradise Rd., Muhlenberg Co.; 11.892 mi. Greenville-Elkton Rd.; 5.548 mi. Graham-Earles Rd., and 8.322 mi. Central City-Earles Rd., all foregoing in Muhlenberg Co.; 6.44 mi. Pikeville-Virginia Rd., Pike Co.

†**Maine**—Oct. 30, by Dpt. Agriculture, Pub. Rds., Troy, N. Y., grading, surfacing Project 5A1, Biz Moose Island-Wonsqueak Harbor, Acadia Natl. Park, Winter Harbor, incl. 31,000 cu.yd. excav. and 2,535 cu.yd. bog excav. A. G. Bruce, dist. engr.

Maryland—Oct. 16, by State Roads Comn., Baltimore, macadam paving 1.19 mi. Millington-McGinnis Rd., Contr. Q-98-1-22 Federal Aid Project NRS 346 (1935) Queen Anne Co.; gravel paving 1.12 mi. Mason Spring-Chicamuxen Rd., Contr. Ch-157-1-82 Federal Aid Project NRS 353 (1935) Charles Co.; concrete paving 0.75 mi. Contr. AA-195-1-79, Federal Aid Project NRS 341 (1935) Anne Arundel Co.

New Jersey—Oct. 22, by State Hy. Dpt., Trenton, rein.-con. paving 34,791 sq.yd. Route S-49, Sect. 4, Contr. B, from Green Creek to Dias Creek Rd. and storm drain at South Dennis, Cape May Co., incl. 14,542 cu.yd. unclass. excav. A. L. Grover, ch. clk.

New York—Oct. 23, by A. W. Brandt, comr. Hys., Albany, graveling 2.44 mi. Cayuga Co.; 4.92 mi. Chenango Co.; preliminary grading, stone faced concrete seawall, Kings Co.; concrete paving 4.77 mi. Schoharie and Otsego Counties; 5.43 mi. St. Lawrence Co.; 32 ft. bridge in Allegany Co.; 50 ft. girder bridge, Chenango Co.; 40 ft. I-beam bridge, Delaware Co.; box culvert in Niagara Co.; sewerage system in Queens Co.

N. Y., Buffalo—Oct. 16, by Bd. Supervs. Erie Co., W. W. Zittel, clk., bituminous macadam repaving 0.604 mi. Military Rd.; 6.277 mi. Harlem Ave.; and 3.912 mi. Seneca St. To exceed $22,000.

N. Y., Buffalo—Oct. 16, by Bd. Supervs. Erie Co., C. H. Fosdick, co. supt. hys., County Hall, bituminous macadam paving 6.277 mi. Harlem Ave.; 3.912 mi. Seneca St.; 0.604 mi. Military Rd. P.W.A. project.

N. Y., New York—Oct. 16, by S. Levy, pres. Manhattan Boro. Municipal Bldg., furnishing, setting and resetting curbing in advance of repaving West 54th and Academy Sts.; granite block on concrete paving West 59th St. and 1st Ave.; widening, asphalt block repaving West 59th St.

N. Y., Syracuse—See "Contracts Awarded."

Ohio—Oct. 19, by O. W. Merrell, dir. Hys., Columbus, bit. surface treatment on waterbound macadam base and brick on concrete paving 0.1303 mi. Sect. "D" (part) and "E" (part) Zanesville-New Lexington Rd., Perry Co., $5,873; grading, drainage structures, concrete widening, landscaping, hot laid asphaltic concrete surfacing, or cold laid asphaltic concrete or tar concrete surfacing 2.608 mi. Sects. "B" and "C" part Toledo-Grand Rapids Rd., Wood Co., $176,622; concrete paving 3.159 mi. Sect. "K" Piqua-Urbana Rd., Champaign Co., $98,672; cold laid asphaltic concrete paving 0.559 mi. Sect. "Kenton and F," Lima-Kenton Rd., Hardin Co., $41,157.

†**Oregon**—Pub. Rds., Post Office Bldg., Portland, bids in fall bituminous surfacing 13.72 mi. Rim Rd., Crater Natl. Park; 4.57 mi. East Enhove Hy., both 18 ft. wide, Klamath Co. W. H. Lynch, Portland, dist. engr.

Pennsylvania—Oct. 19, at office S. S. Lewis, secy. Hys., Harrisburg, 20 ft. wide rein.-con. paving 16,151 ft. and 16 ft. wide (on side roads) paving 805 ft. R-52, Sect. R-4, East Taylor and Jackson Twps., Cambria Co., involving 70,767 cu.yd. Class 1, 928 cu.yd. Class 2 and

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411 cu.yd. borrow excav.; 16,251 ft. R-52, Sect. R-5, Cambria Co., 66,332 cu.yd. Class 1 and 1,081 cu.yd. Class 2 excav.; 17,846 ft. R-73, Sect. 3, Mercer Borough, Findley Twp., Mercer Co., 14,362 cu.yd. Class 1, 2,004 cu.yd. Class 2 and 661 cu.yd. borrow excav.; 2,741 ft. R-646, Sect. 2, Hatfield Borough, Montgomery Co., 525 cu.yd. Class 2 excav.; rein.-con. paving and grading road approach 5,888 ft. R-162, Sect. 5, Mauch Chunk Twp., Carbon Co., 5,605 cu.yd. Class 1, and 220 cu.yd. Class 2 excav.; bituminous surface course Spec. E surfacing 5,416 ft. existing pavement, R-190, and 342, Hanover Borough, York Co. P.W.A. project.

CONTRACTS AWARDED

†**Arizona**—Pub. Rds., Phoenix, grading, draining 9.14 mi. roadbed in Coconino Co., to G. R. Daley and Vincent & Pringle, Phoenix, $184,858. Est. $210,210. Bids Sept. 13.

California — State Hy. Comn., Sacramento, grading, oil treating (road mix method) and constructing bridge over San Antonio Creek, on 3.8 mi. hy. between Hollister Ave. and Pointed Cave Rd., Santa Barbara Co., to Granfield, Farrar & Carlin, 67 Hoff St., San Francisco, $368,268. Bids Sept. 12, awarded Sept. 27. Noted Aug. 30.

†**Colorado**—Pub. Rds., Denver, grading 5.879 mi. road in Larimer Co., to Platt-Rogers, Inc., Pueblo, $133,228. Bids Sept. 12, awarded Sept. 25. Noted Sept. 6.

Colorado—State Hy. Dpt., Denver, gravel surfacing 5.708 mi. hy. east and west of Elk Springs on State Hy. 2, NRH 150-H (1935) Moffat Co., to Garner Bros., Longmont, $113,068; gravel surfacing 15.59 mi. hy. between Pueblo and Canon City on State Hy. 6, NRH 271-D (1935) and NRH 271-I (1935) Pueblo Co., to Driscoll Constr. Co., Pueblo, $193,746. **P.W.A.** Bids Sept. 25, awarded Sept. 29.

Indiana—State Hy. Comn., Indianapolis, bitum. mulch-liquid asphalt surfacing 8.2 mi. road in Scott Co., to L. Dehner, Kokomo, $29,435***6.8 mi. Scott Co., to Road Resurfacing Co., Bloomington, $27,523***5 mi. Switzerland Co., to Bituminous Material Co., Terre Haute, $21,326. Grand total $78,284.

Illinois—Dpt. P. Wks. & Buildings, Div. Hys., Springfield, paving 9.2 mi. Route 145, Sect. 102, from Metropolis easterly and north toward Route 146, Massac Co., to Stanley Jaicks Co., Winfield, $193,053***7.03 mi. Route 145, Sect. 103, from Route 146 south toward Metropolis, in Massac and Pope Counties, to Waukegan Constr. Co., Waukegan, $146,338. Bids Sept. 25.

Ill., East St. Louis—Dpt. P. Wks. & Buildings, Div. Hys., asphalt on concrete resurfacing State St., to Webb-Boone Paving Co., 5103 Fyler Ave., $27,464. Est. $44,500. Bids Sept. 19.

Iowa—State Hy. Comn., Ames, concrete paving 2.531 mi. Black Hawk and 6.157 mi. Plymouth Co., to Booth & Olson, Inc., Sioux City, $53,130 and $129,331 respectively***2.03 mi. Scott Co., to Central Eng. Co., Davenport, $146,068. Grand total $328,529. **P.W.A.** Bids Sept. 25. Noted Sept. 20.

Iowa—State Hy. Comn., Ames, grading 6.934 mi. road in Ringgold Co., to Griffis Bros. Constr. Co., Wellman, $30,707. **P.W.A.** Bids Sept. 12. Noted Sept. 6.

Iowa—State Hy. Comn., Ames, grading, concrete paving 10,362 sq.yd. road in Centerville, to Union Constr. Co., 200 New York St., Des Moines, $32,288; grading 6,602 mi. NRH 373-E, Lee Co., to Burch Constr. Co., Ottumwa, $25,112. **P.W.A.** Bids Sept. 25. Noted Sept. 20.

Kansas—State Hy. Comn., Leavenworth, (**P. means Project**) to B. Metzger, Ozawkie, sand gravel paving 3.812 mi. P. 24-8 NRH 420 A, Jackson Co., $5,490; 0.698 mi. P. 4-29 NRM (1935) $879; 0.191 mi. P. 4-28 NRH 173 B (1935) $228; 0.704 mi. P. 4-27 NRH 222 B (1935) $888; 1.85 mi. P. 24-9 NRH 420 B, $2,581; 4.935 mi. P. 24-9 NRH 420 C (1935) $6,619; 0.826 mi. P. 24-9 NRH 420 D (1935) $1,042; 0.43 mi. P. 92-1F NRM 268 C (1935) $542; 4.185 mi. P. 92-1F NRH 268 C (1935) $5,461; 1.338 mi. P. 93-1F NRH 268 J (1935) $1,806, all foregoing Jefferson Co.***to A. V. Eulich, 5436 Charlotte St., Kansas City, Mo., 3.855 mi. P. 11-23 NRH 432 A (1935) $3,331; 0.432 mi. P. 11-23 NRH 432 D (1935) $373, both Pottawatomie Co. Grand total $29,240. **P.W.A.** Bids Sept. 14, awarded Sept. 25.

Kansas—State Hy. Comn., at office County Clerk, Abilene (**P. means Project**), to More Sand Co., Junction City, sand graveling 4.844 mi. P. 18-14 NRH 481 C (1935) $5,058; 8.293 mi. P. NRS 481E (1935) $7,988, both Dickinson Co.; 6.302 mi. P. NRS 481 D (1935) Geary Co., $5,048***to Cook & Cone, Ottawa, 9.626 mi. P. 28-6 NRS 478 A (1935) Jewell Co., $7,537***to D. G. Hansen, Logan, 3.426 mi. P. 40 N-17 NRH 371 G (1935) Mitchell Co., $3,515. Grand total $28,846. **P.W.A.** Bids Sept. 15, awarded Sept. 25.

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Kansas—State Hy. Comn. at office of City Clerk, Oakley, (**P. means Project**) to D. G. Hanson, Logan, sand gravel surfacing 3.599 mi. P. 21-15 NRH 413 A (1935) Graham Co., $3,045; 1.341 mi. P. 1-19 NRH 204 C (1935) $1,654; 4.717 mi. P. 1-20 NRH 204 D, $5,816; 6.785 mi. P. 1-19 NRH 204 E (1935) $8,365, all foregoing in Phillips Co.***to D. H. Hardman, Alton, 2.968 mi. P. 83-13A NRH 247 A, $2,164; 5.922 mi. P. 83-13A NRH 247 D (1935) $4,317; 4.253 mi. P. 83-13A NRH 247 E (1935) $3,101; 7.833 mi. P. 83-13A NRH 247 F (1935) $5,711, all foregoing Logan Co.; 10.949 mi. P. 25-14 NRH 241 D (1935) Rawlins Co., $9,755; 1.989 mi. P. 25-13 NRH 241 A (1935) $1,773; 4.036 mi. P. 25-13 NRH 241 B (1935) $3,596; 4.985 mi. P. 25-13 NRH 241 C (1935) $4,442; 0.47 mi. P. 25-13 NRH 241 E (1935) $419, all foregoing Thomas Co.***to Stamey & Tidd, Hutchinson, 7.816 mi. P. 21-14 NRH 413 B (1935) Trego Co., $5,698***to San-Ore Constr. Co., McPherson, 0.406 mi. P. 1-18 NRM 204 B1 (1935), $354; 8.04 mi. P. 1-18 NRH 204 B2 (1935) $7,019, both in Rooks Co. Grand total $67,229. **P.W.A.** Bids Sept. 18, awarded Sept. 25. Noted Sept. 13.

Kansas—State Hy. Comn., at office of County Clerk, Jetmore (**P. means Project**), to C. Hulme, Great Bend, sand gravel surfacing 5.233 mi. P. 160-12A NRH 438 B (1935) Clark Co., $4,379; 11.004 mi. P. 50N-7 NRH 359 A (1935) $8,319; 10.726 mi. P. 21-9 NRH 440 C (1935) $7,047; 0.652 mi. P. 21-9 NRH 440 D (1935) $557; 0.651 mi. P. 21-9 NRH 440 E (1935) $363, all foregoing in Hodgeman Co.; 5.946 mi. P. 160-11 NRH 439 D (1935) Meade Co., $5,941; 3.625 mi. P. 21-10 NRH 440 A (1935) $2,806; 0.623 mi. P. 21-10 NRM 440-A1 (1935) $511; 7.813 mi. P. 21-10 NRH 440 B (1935) $4,852; 1.031 mi. P. 21-10 NRH 440 F (1935) $575, all foregoing Ness Co.***to Cook & Cone, Ottawa, 10.87 mi. P. 23-3 NRS 471 B (1935) Gray Co., $9,587; 11.951 mi. P. 23-2 NRS 471 A (1935) Meade Co., $12,262. Grand total $57,199. **P.W.A.** Bids Sept. 19, awarded Sept. 25. Noted Sept. 13.

Kansas—State Hy. Comn., at office of County Clerk, Eureka (**P. means Project**), to Cook & Cone, Ottawa, chat surfacing 3.838 mi. P. 96-27 NRH 448 A (1935) $4,452; 0.876 mi. P. 96-28 NRH 448 D, $1,016; 10.687 mi. P. 96-28 NRH 448 E (1935) $12,398, all foregoing in Greenwood Co.; 0.358 mi. P. 96-29 NRH 448 D (1935) $415; 6.68 mi. P. 96-29A NRS 486 A, $7,749; 1.098 mi. P. NRS 486 B (1935) Wilson Co., $1,264. Grand total $27,294. **P.W.A.** Bids Sept. 21, awarded Sept. 25. Noted Sept. 13.

Kansas—State Hy. Comn., Medicine Lodge, (**P. means Project**), to Banta Constr. Co., Harper, earthwork and culverts 2.961 mi. hy., $25,483; Bridge 1, two 12x12x70 ft. rein.-con., $6,443; 2.961 mi. roadside improvement, $585, all foregoing on P. 160-20 NRH 451 B-1 (1935) Barber Co.***to San-Ore Constr. Co., McPherson, bit. mat. surfacing (road mix method) 1.296 mi. P. 41-1 NRS 513-A (1935) Comanche Co., $5,276; bit. mat. surfacing (trav. plant method), 7.844 mi. P. 50N-12 NRH 139-2 (1935) Pawnee Co., $22,360***to Geiger & Rutherford, Leavenworth, earthwork and culverts 0.708 mi. P. 166-3 NRH 356 H (1935), Cowley Co., $27,342***to Stamey & Tidd, Hutchinson, roadside improvement 0.708 mi. P. 166-3 NRH 356 H (1935) Cowley Co., $159. Grand total $87,648. **P.W.A.** Bids Sept. 25. Noted Sept. 20.

Kansas—State Hy. Comn., Ellsworth (**P. means Project**) to A. L. Cook, Ottawa, roadside improvement, 5.552 mi. P. 15-15 NRH 370 D (1935) Dickinson Co., $530; 3 mi. P. 40S-14 NRH 436 B (1935) Ellsworth Co., $149*** to C. E. Gray, Emporia, earthwork and culverts 5.552 mi. P. 15-15 NRH 370 D, $42,016; Bridge 1, two 14x15x32 ft. rein.-con., P. 15-15 NRH 370 D (1935) $4,192; Bridge No. 2, four 8x78x32 ft. rein.-con., P. 15-15 NRH 370 D (1935), $2,442, all foregoing in Dickinson Co. ***to Harrison Eng. & Constr. Corp., Fairfax Bldg., Kansas City, Mo., concrete paving 3 mi. P. 40S-14 NRH 436 B, (1935) Ellsworth Co., $76,041. Grand total $125,369. **P.W.A.** Bids Sept. 28. Noted Sept. 20.

Me., Portland—City, W. O. Thompson, purch. agt., City Hall, recut granite block paving Commercial St., to R. Kennedy, 16 Nevens St., $20,843. **P.W.A.** Bids Sept. 26, awarded Oct. 2.

Maryland—State Roads Comn., Baltimore, macadam paving 2.27 mi. Contr. Q-95-1-22, P.W.A. Queen Anne Co., to T. Edgie Russell Co., Frederick, $20,482. Bids Aug. 28. **P.W.A.** Noted Aug. 23.

Maryland — State Roads Comn., Baltimore, gravel paving 2.56 mi. Contr. P-283-1-7[illegible] eral Aid Project NRS 339-C (1935) P. George Co., to Jarboe & Haughton, Mechanicsville, $48,405. **P.W.A.** Bids Sept. 11.

Massachusetts—G. F. Jenkins, chn. Bd. Sewermen, town of Gosnold at office Dpt. P. W., 100 Nashua St., Boston, bituminous concrete paving 5.571 ft. State Aid Project, Gosnold, to O. R. Mann, Hanover, $22,637. Bids Sept. awarded Sept. 28.

Michigan—State Hy. Comn., Lansing, grading, shaping, concrete paving 0.359 mi. [illegible] 77-45C-1, St. Clair Co., to W. E. Malow, [illegible] $15,366***grading, shaping, drainage, concrete paving 1.535 mi. NRH 50-6C-3, and NRM [illegible] 6C-4, Macomb Co., to Taylor Bros. Co., [illegible] Birmingham, $55,706***grading, shaping, drainage, brick paving 0.605 mi. NRM 13-3[illegible] Calhoun Co., to Grace Constr. & Supply, [illegible] Marshall, $88,459. Grand total $15[illegible] **P.W.A.** Bids Sept. 21.

Minnesota—State Hy. Dpt., St. Paul, bituminous surfacing 11.9 mi. State Project 8-4[illegible] NRH and M 95A and B, in Lindstrom, to Megarry Bros., Bain, $70,791. Bids Sept. [illegible] Noted Sept. 5.

New Hampshire—State Hy. Dpt., Concord, [illegible] in. gravel surfacing 24,288 cu.yd. Swift R[illegible] Rd., Albany and Conway, 20 ft., to T. E. Ma[illegible] Gorham, $78,705. Est. $80,000. **P.W.A.**

New Hampshire—State Hy. Dpt., Concord, 4 in. on 5 in. gravel surfacing 2.104 mi. Forest Rd., Stoddard, Cheshire Co., to Lane Const. Co., 37 Colony St., Meriden, Conn., $35,07[illegible] Est. $40,000. **P.W.A.** Bids Sept. 20. Noted Sept. 13

New Hampshire—State Hy. Dpt., Concord, premixed asphalt shoulders 1.49 mi. Project 129-H, Concord, to Winslow & Cummings-Nashua, $10,625***rein.-con. paving 0.935 mi. Project 219-I, Concord, to New Haven Road Constr. Co., 1817 Dixwell Ave., New Haven, Conn., $47,670. Bids Sept. 13, awarded Sept. 27.

New Hampshire—State Hy. Dpt., Concord, [illegible] in. one course rein.-con. on gravel paving 7,627 sq.yd. Pleasant St., Berlin, Coos Co., to Central Constr. Co., Lawrence, Mass., $49,754. est. $80,000; 3 in. asphalt on gravel and broken stone paving 0.293 mi. South Side Rd., Milford, Hillsboro Co., to Winslow & Cummings-Nashua, $10,206 est. $15,000. Bids Sept. [illegible]

New Jersey—State Hy. Comn., Trenton, rein. con. paving 1.335 mi. road in Passaic Co., to G. M. Brewster, Bogota, $118,021. Est. $118,021. Bids Sept. 24. Noted Sept. 13

N. Y., Oneonta—Dpt. Health, State Office Bldg., Albany, Oct. 2, constructing road at Oneonta State Tuberculosis Hospital, to J. J. Bellotte & Son Constr. Co., Troy, $28,8[illegible] Noted Sept. 27.

N. Y., Syracuse—Onondaga Co., gravel surface and calcium chloride binder on 7 mi. Monro, Chestnut Ridge and Hinsdale Rds., day labor, $25,000.

†**N. Y., Syracuse**—Treas. Dpt. at office Supt. Archt., Wash., D. C., sidewalks and driveway repairs, to Mondo Constr. Co., 417 South Townsend St., $4,345.

North Carolina—State Hy. & P. Wks., Raleigh, grading, stone and bituminous surface treating 5 mi. Project 9891, Transylvania Co., to T. M. Strider & Co., Cotton States Bldg., Nashville, Tenn., $72,389. Bids Sept. 12.

North Carolina—State Hy. and P. Wks., Raleigh, to F. C. Cline, Raleigh, grading, sand asphalt paving, structures 5.79 mi. Project 1023, Beaufort and Pamlico Counties, $64,590***to Kiker & Yount, Reidsville, bituminous surface treating 10.84 mi. Project 1515, $28,986; 11.98 mi. Project 1516, $32,912, both Hyde Co.; 4.61 mi. Project 4993, Warren Co., $31,612***to Gregory-Chandler Co., Inc., Virgilina, Va., 2.39 mi. Project 4782, Wake Co., $7,528***to Reed & Abee, Asheville, 0.49 mi. Project 9024, Buncombe Co., $2,587***to C. A. Ragland, Louisburg, artificial sand clay and crusher run stone surfacing 6.93 mi. Project 6454, Lincoln Co., $31,388; grading, gravel surfacing 5.71 mi. Project 8141, Caldwell and Burke Counties.

†*Federal Government.*

Streets and Roads (Continued)

$54,106***to Blythe Bros., Inc., 422 South Brevard St., Charlotte, sand asphalt paving 4.39 mi. Project 6671, Richmond Co., $59,775***to F. A. Triplett, Chester, S. C., structures 5.71 mi. Project 8141, Caldwell and Burke Counties, $16,200. Grand total $329,684. Bids Sept. 26.

North Dakota — State Hy. Dpt., Bismarck, bituminous concrete paving 0.919 mi. road in Linton, Emmons Co., to Albert Graff Co., Bismarck, $27,760. **P.W.A.** Bids Sept. 14.

Oregon—State Hy. Comn., Pub. Service Bldg., Portland, surfacing Wolf Creek Hy., to Saxton-Looney, Corvallis, $63,285***grading Wolf Creek Hy., Ranger Station-Elsie Station, alternate 1a, to F. H. Slate, Multnomah, $94,181***paving Portland-Washington Co. line Rd., West Side Pacific Hy., to Jacobsen-Jensen, 517 Northeast Stanton St., Portland, $145,725***grading, surfacing Spencer Butte Sect., Fox Hollow Secondary Hy., to E. McNutt, Eugene, $12,110*** paving Willamette Hy., Gold Lake Trail-Odell Lake Section Rd., to Dunn & Baker, Klamath Falls, $123,809***Forest Boundary-Long Creek Rd., Pendleton John Day Hy., to Wren & Greenbough, 485 North 28th St., Portland, $97,790 ***Rock Creek and Eagle Creek, Woodburn-Sandy Secondary Hy., to Itschner & Rigdon, Barlow, $14,555. Grand total $551,455. Bids Oct. 1. Noted Sept. 27.

South Dakota—State Hy. Comn., Pierre, grading 7.28 mi. Lawrence Co., to Jahnig & Davis, Britton, $35,492***5.988 mi. Clay Co., to A. A. Mettler, Mitchell, $22,708***6.6 mi. Sanborn Co., to Strong & Waggoner, Mitchell, $22,392*** 9.427 mi. Roberts Co., to M. E. Lein, Veblen, $32,895***4.72 mi. Jones Co., to England & England, Murdo, $17,014***5.379 mi. Marshall Co., to E. C. Schoen & Son, Langford, $10,508 ***6.947 mi. Spink Co. and 5.054 mi. road in Spink Co., to Jarvis, Wright & Howell, Sioux Falls, $19,722 and $12,069 respectively*** graveling 9.132 mi. Hand Co. and 9.849 mi. Douglas Co., to J. L. Healy Constr. Co., Manchester, $5,937 and $6,280 respectively***7.118 mi. Charles Mix Co., to M. Joyce, Brandon, $6,213***7.11 mi. Potter Co. and 9.167 mi. Campbell Co., to W. E. Barthlow & Son, Huron, $14,226 and $11,222 respectively***4.04 mi. Hamlin Co. and 3.958 mi. Brookings Co., to F. Schuknecht, Jr., Parker, $3,207 and $3,160 respectively***4.021 mi. McCook Co., to Lindekuzel & Kolberg, Spencer, $2,987***6.011 mi. Potter Co., to Barthlow & Sons, Huron, $6,108 ***6.196 mi. Brown Co., to Larson Eng. Co., Sioux Falls, $9,268. Grand total $241,348. Rejected bids Sept. 6 roads in Yankton, Campbell, Gregory, Jones, Jerauld, Charles Mix, and Lincoln Counties. **P.W.A.** Bids Sept. 6. Noted Aug. 30.

†**Tennessee**—Pub. Rds., Dpt. Agriculture, at office acting superintendent Meriwether, Lewis Natl. Monument, improving roads, to Municipal Paving & Constr. Co., Cotton States Bldg., Nashville, $70,376. Bids Sept. 21. Noted Sept. 13.

Tenn., Nashville—City, S. H. McKay, clk., City Hall, improving 13 streets, P.W.A. Dockets C and D, to Eller & Olson, 32nd Ave. N., $24,938 and $28,675 respectively***P.W.A. Dockets E and F, to T. M. Strider, Cotton States Bldg., $38,402 and $48,461 respectively. Grand total $140,476. **P.W.A.** Bids Sept. 25.

Texas—G. Gilchrist, state hy. engr., Austin, grading, drainage structures, concrete paving 1.107 mi. State Hy. 2, NMR 140-B, Part 4, Williamson Co., to Froemming Bros., Dallas, $74,447. Est. $80,000. **P.W.A.** Bids Sept. 10. Noted Sept. 6.

†**Utah**—Bureau Reclamation, Ogden, constructing relocated Huntsville Highway, at Pine View Reservoir, Ogden River Project, near Ogden, to Utah Constr. Co., Ogden, Utah, and Morrison-Knudsen Co., Boise, Idaho, $100,596. Bids Sept. 17. Noted Sept. 6.

Vermont—State Hy. Dpt., H. E. Sargent, ch. engr., Montpelier, gravel mixed in place paving 2 mi. Project NRS 157, Route 100B, Moretown, to Lane Constr. Co., 37 Colony St., Meriden, Conn., $25,700***1.6 mi. Route 116, Shelburne St., George and Hinesburg, NRS 140 B, to Ellsworth H. Lewis, Andover, Mass., $28,620*** grading, base and drainage 0.7 mi. Route U. S. 2, NRH 128-B, Grand Isle, to Earle & Merry, Rutland, $9,490. Grand total $63,816. **P.W.A.** Bids Sept. 14, awarded Sept. 28.

Washington—State Hy. Comn., Olympia, grading 1.003 mi. in Lewis Co., to A. C. Greenwood Co., Inc., 3201 Northwest Front Ave., Portland, Ore., $17,376***concrete paving 1.562 mi. road in Pierce Co., 10 ft. additionad width, to J. Warter, Sr., 631 North Fife St., Tacoma, $29,363***constructing bridge on Road 5, in Lewis Co., to Western Constr. Co., 1008 Textile Tower, Seattle, $19,885***bridge in Grays Harbor, to Sheble Constr. Co., 103 Securities Bldg., Seattle, $81,410. Grand total $148,034. **P.W.A.** Bids Sept. 25. Noted Sept. 13.

(Federal Government.

Wisconsin—State Hy. Comn., Madison, concrete paving 0.738 mi. road and 3.04 mi. road in Outagamie Co., to Koepke Bros., Inc., 201 East College Ave., Appleton, $14,658 and $56,148 respectively***0.303 mi. Langlade Co., to Simpson-Parker, 318 East Franklin St., Appleton, $8,776***grading, draining 4.484 mi. Waukesha Co., to F. C. Raemisch, Waunakee, $24,455***0.954 mi. Langlade Co., to Nimergood-Kubicek Co., 2530 North 52nd St., Milwaukee, $12,695***5.382 mi. Oneida Co., to V. and J. Theiler, Tomahawk, $83,382***1.235 mi. Oneida Co., to H. S. Kaliher, Washburn, $8,379*** 4.682 mi. Dade Co., to W. Lathers, 216 Virginia Terrace, Madison, $72,128***graveling 4.484 mi. Waukesha Co., to B. R. Amon, Elkhorn, $10,274***3.236 mi. Manitowoc Co., to Streu Constr. Co., Two Rivers, $9,388***3.236 mi. Manitowoc Co., to Leesley Nurseries, Libertyville, Ill., $413, all foregoing **P.W.A.*****5.234 mi. Dunn Co., to Colburn-Thurston Co., Anoka, $49,335***1.975 mi. Vernon Co., to C. H. Peterson & Co., 610 Wesley Temple Bldg., Minneapolis, Minn., $17,948***2.483 mi. Vernon Co., to F. Kutzke, Brooklyn, $15,667. Grand total $483,646. Rejected bids Sept. 25, stone surfacing 5.234 mi. road in Dunn Co.; 1.976 mi. Vernon Co. and graveling 2.483 mi. in Vernon Co. Beds Sept. 25. Noted Sept. 13.

Wis., Elroy—City, grading, curbing, guttering, sewers, asphalt and macadam surfacing roads, to Fox Valley Constr. Co., Appleton, $22,649. **P.W.A.** Bids Sept. 17. Noted Sept. 13.

†**Wyoming**—Pub. Rds., Denver, Colo., oiling 22.986 mi. Cody-Yellowstone Natl. Forest Rd. Park Co., to Taggart Constr. Co., Cody, $21,153. Noted Sept. 6.

†**Wyoming**—Pub. Rds., Denver, Colo., surfacing 7.242 mi. Fremont Co., to Morrison-Knudsen, Boise, Idaho, $109,663. Bids Sept. 14, awarded Sept. 25. Noted Sept. 6.

†**Wyoming**—Pub. Rds., Denver, placing crusher run sub-base on 14.85 mi. roadbed in Albany Co., to C. V. Hallenbeck, 251 Kalamath St., Denver, Colo., $49,975. Bids Sept. 14. Noted Sept. 6.

Ont., Toronto—York Twp., H. C. Rose, engr., 57 Adelaide St. E., paving Woodbine Bridge approach, to A. E. Jupp Constr. Co. Ltd., 170 Berkeley St., $40,000.

EARTHWORK, IRRIGATION DRAINAGE AND WATERWAYS

PROPOSED WORK

Calif., Long Beach—City plans improving Rivo Alto, Naples and Colonade Canals consisting of reinforced sheet piling retaining walls, creosoted anchor piles, tie rods, galvanized pipe hand rails, earth fills, removal of portions of existing concrete retaining walls, coping, steps, light standards, etc. $316,300. A. H. Adams, City Hall, engr. Supervs. Los Angeles Co. have appropriated $100,000 to city to finance above improvements.

Calif., Los Angeles—Los Angeles Co. Flood Control Dist., 205 South Bway., S. M. Fisher, engr., study authorized by Bd. Supervs. is being made to determine cost estimates for proposed flood prevention in sections of Los Angeles County where it is most needed. It is proposed to submit a bond issue to the voters at November general election to finance work. Amount of proposed issue to be determined from cost data being prepared by H. E. Hedges, office engr. of Dist.

Calif., Los Angeles—Flood Control Dist., 205 South Bway., S. M. Fisher, engr., plans construction 5 ft. diam. concreted lined tunnel to divert flood waters from spoil banks (created during construction of San Gabriel Dam 1) to protect Morris Dam Reservoir. (formerly Pine Canyon Dam constructed in San Gabriel Canyon downstream from San Gabriel Dam 1). $70,000. City of Pasadena approved project.

Calif., Los Angeles—Flood Control Dist., 205 South Bway., S. M. Fisher, engr., election Nov. 6, $26,332,500 (tentative amount), for 20 flood control projects estimated to cost $30,200,000 as proposed construction, incl. La Crescenta, La Canada, Verdugo Wash, and Haines Canyon, $4,150,000; Ballona Creek, $8,882,000; Lower Los Angeles River, $605,000; Central San Gabriel River, $1,403,000; Lower San Gabriel River, $1,525,500; Outlet San Gabriel River, $215,000; Compton Creek, $2,969,000; Alhambra Wash, $1,250,000; Eaton Wash, $1,229,000; Burbank Wash, $910,000; Rubio Wash, $411,000; Upper Los Angeles River, $313,000; La Verne Area, $252,000; Santa Anita Wash, $366,000; Wilson and May Canyons, $561,000; Central Los Angeles River, $395,000; Sycamore Wash, $90,000; Kenter Canyon (Santa Monica) $7,500,000; Long Beach, N.E. drainage, $5,580,000; Sawtelle-Westwood, $2,100,000; Arroyo de las Jardines, drainage, $361,000. Noted Sept. 21.

Calif., Martinez—City voted $38,000 for yacht harbor development, incl. 900 ft. pier extension, boat landing facilities, dredging piling, levees, etc. $15,000 grant made by P.W.A. E. G. Banks, 411 13th St., Oakland, archt. L. M. King, 1339 Grove St., Alameda, engr. Noted Aug. 30.

†**Florida**—U. S. Eng., Wash., D. C., making plans and surveys for deepening Palm Beach Harbor from 16 to 20 ft.

†**Florida**—U. S. Eng., Jacksonville, preparing permanent plans and estimates for draining Kissimmee Valley in lower central Florida to drain 1,500 sq.mi. cattle grazing lands. Temporary relief underway and permanent measures will be taken when plans are completed.

†**Ia., Guttenburg**—U. S. Eng., Rock Island, Ill., bids latter part November, constructing Dam 10 on Mississippi River.

†**Nevada**—Bureau Reclamation, Denver, Colo., soon takes bids constructing Rye Patch dam across Humboldt River to store water for irrigation in Lovelock Valley, $1,600,000. P.W.A. funds allotted. R. F. Walter, ch. engr. Noted Mar. 22.

N. M., Fort Sumner—Fort Sumner Irrigation Dist., rejected bids Aug. 22, constructing concrete diversion dam on Pecos River, enlarging present canal system, constructing syphons and drops and high line lateral. $122,000. Noted Aug. 16.

N. Y., Lakewood — Chautauqua Co. plans channel improvements in Chautauqua Lake, dredging, etc., incl. using copper sulphate treatment of algae-covered water. To exceed $17,500. E. Fitch, Falconer, co. engr.

Que., Montreal—Engineers representing the Dpts. of Marine, Railways & Canals, Pub. Wks. and Interior, Ottawa, Ont., have submitted a joint report to the Dominion Govt. recommending extensive weirs in Lake St. Peter, Lake St. Louis and Lake St. Francis. $15,000,000. N. B. McLean, Dpt. Marine, Ottawa, Ont., engr.

BIDS ASKED

Calif., Richvale—A. Harris, secy., Irrigation Dist., taking bids constructing and repairing reinf.-con. siphon under Cherokee Canal, involving 900 cu.yd. excav., 19,000 lb. reinforcing steel, 150 cu.yd. concrete.

†**Ill., Chicago**—Oct. 17, by U. S. Eng., 932 Post Office Bldg., Canal and Van Buren Sts., dredging 49,300 cu.yd. material from Chicago Harbor.

†**Ill., Joliet**—Oct. 23, by U. S. Eng., Post Office Bldg., Chicago, constructing concrete retaining wall and widening channel in Des Plaines River at Ruby St.

†**Ia., Muscatine**—U. S. Eng., Rock Island, Ill., bids about Nov. 6, constructing Dam 16, incl. 4 roller gates, 20 taintor gates and 1,700 ft. concrete spillway in Mississippi River.

†**Md., Sollers Point**—Oct. 19, by Dpt. Agriculture, constructing concrete retaining wall at U. S. Animal Quarantine Station.

†**Mo., Clinton**—Oct. 24, by U. S. Eng., Rock Island, Ill., constructing remedial works at Lock and Dam 20, Mississippi River, near here.

Nebraska—Oct. 19, by Platte Valley P.P. and I. Dist., North Platte, completing canal excavation and earthwork from Station 50 plus 00 to Station 540 plus 00, in neighborhood between Genoa and Monroe, incl. 2,500,000 cu.yd. earth excav., and is approximately 27% of the total contemplated canal excavation. D. D. Price, North Platte, engr.

Nebraska—Oct. 22, by Platte Valley P.P. & I. Dist., North Platte, constructing and regulating reservoir, power canal and forebay of Sutherland Project, about 4 mi. south of North Platte, incl. reservoir, power canal, forebay dike, several smaller dikes, 1,000,000 cu.yd. rolled embankment, 650,000 cu.yd. canal excav., 16,000 cu.yd. concrete, 200 tons reinforcing steel and wire mesh, 2 timber bridges and other minor construction. D. D. Price, North Platte, engr. Noted July 26.

New Jersey—Oct. 15, at office Bd. Commerce & Navigation, State House, Trenton, dredging channel in Cedar Run Creek, Stafford Twp., Ocean Co. V. Gelineau, dir. and ch. engr.

Pa., Lock Haven—See "Contracts Awarded."

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Earthwork, etc. (Continued)

Que., Pointe-au-Pic—Oct. 16, by Secretary Dpt. P. Wks., Ottawa, Ont., wharf extension and repairs, involving 1,870 cu.yd. reballasting, 19,000 cu.yd. stone back filling, 11,000 ft. B.M. wooden floor, 748 tons coppered steel sheet piling, 12.5 tons steel channels, girders and I-beams, 55 tons coppered steel tie rods and 800 sq.yd. bituminous macadam paving, $126,000. K. M. Cameron, Ottawa, Ont., engr.

LOW BIDDERS

†Wis., Trempealeau—U. S. Eng., 615 Commerce Bldg., St. Paul, Minn., Oct. 2, constructing Dam 6 in Mississippi River, from Spencer, White & Prentis, 10 Est 40th St., New York, N. Y. $1,668,441. Noted Sept. 13.

CONTRACTS AWARDED

Calif., San Francisco—Public Utilities Comn., City Hall, placing rip rap on Calaveras Dam, Spec. W.D. 63, involving 6,750 cu.yd. rip rap pavement on upper stream slope, 600 cu.yd. miscellaneous grading, to E. T. Lesure, 87 Ross Circle, Oakland, $25,808. Bids Sept. 11, awarded Sept. 28.

†Idaho, Shoshone—Big Wood Canal Co., Shoshone, furnishing two 60 in. needle valves and emergency gates for reconstructing Magic Dam outlet work, to Hardie Tynes Co., 800 North 28th St., Birmingham, Ala., $50,590; stand pipe (exceed 100 tons), to Babcock & Wilcox, 85 Liberty St., New York, and Denver, Colo. Noted Aug. 30.

†Louisiana—U. S. Eng., New Orleans, to Brooks-Callaway Co., Healey Bldg., Atlanta, Ga., 520,000 cu.yd. Item MVR-E, Melville Ring Levee on Atchafalaya River, $62,400; 450,000 cu.yd. Item MVR-D, same levee, $60,750; 460,000 cu.yd. Item MVR-C, same levee, $64,400; 670,000 cu.yd. Item MVR-B, levee, $87,100; 710,000 cu.yd. Item MVR-A, same levee, $85,200. Grand total $359,850.

Maryland—Comrs. Anne Arundel Co., Court House, Annapolis, constructing 8,100 ft. timber bulkhead to protect North Beach Park from erosion, to Brundage & Crandall, Sudley, $78,678. Bids Sept. 18. Noted Sept. 13.

†Mississippi—U. S. Eng., Vicksburg, 40,000 cu.yd. earthwork on south bank Arkansas River, in Arkansas, to J. C. Leathers, Alexandria, La., at 33c. per cu.yd. Bids Sept. 14. Noted Sept. 6.

Ohio—T. S. Brindle, dir. P. Wks., Columbus, repairing dam in Walholding River known as Six Mile Dam, Coshocton Co., to C. P. Brindle, Route 5, Akron, $13,034. F. O. Kugel, State Office Bldg., Columbus, engr. Bids Aug. 15.

O., Springfield—Conservancy Dist., channel improvement to Buck Creek, erect 3 bridges, etc., $318,000. District to buy materials and complete as FERA project. Morgan Eng. Co., Dayton, engr.

Pa., Lock Haven—City and Clinton Co. Comrs., concrete dam in Susquehanna River, Lock Haven, as work relief project to replace old dam built in 1904, day labor. Est. $105,000. Project approved, $25,000 will be expended for materials.

Ont., Orillia—Orillia Power & Light Com., F. H. Horn, chn., 19 Tecumseh St., constructing dam and power house at Workman's Falls, Gull River, near Minden, to Dominion Constr. Corp., Ltd., 217 Broadway, Toronto. Contract for turbines and transmission line materials not awarded. Noted May 31, under "Public Buildings."

UNCLASSIFIED

PROPOSED WORK

California—NATURAL GAS PIPE SYSTEM—Cities of Visalia, Porterville, Lindsay and other towns in Tulare County will form district to finance installation of pipe lines for natural gas distributing system from Kettleman Hills oil fields. To exceed $50,000.

California—RAPID TRANSIT SURVEY—Bd. Supervs, San Mateo Co., selected B. J. Arnold as consult. engr., 231 South La Salle St., Chicago, Ill., to make survey and recommendations for extension of rapid transit service from San Francisco to peninsula communities.

Calif., San Francisco—RAILROAD TRACKS—Public Utilities Comn., City Hall, rejected bids Sept. 5, reconstructing 2,230 ft. railroad tracks of municipal railway in Market St. between Sutter and Geary Sts., for City and San Francisco Co.

†Calif., San Rafael—FENCE, etc.—Con. Q.M., Hamilton Field, rejected bids July 17, 734 lin. ft. fence, two 20 ft. and one 26 ft. gateways, at Hamilton Field.

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Conn., Winsted—SWIMMING POOL, etc.—Town of Winchester, Bd. Selectmen, making plans swimming pool, Winsted Playgrounds, new park on Boyd St. and constructing dyke east side Forest View Cemetery. To exceed $17,750.

Ky., Ashland—MARINE TERMINAL—Ashland By-Product Coke Co., plans marine terminal on left bank of Ohio River, comprising of floating dock and structural steel conveyor system of 2 belt conveyors, etc.

†La., New Orleans—DECK WHARF—Superintendent Lighthouses, New Orleans, making plans constructing 30x500 ft. concrete deck wharf on creosoted piles, for proposed new U. S. Lighthouse Depot, on Industrial Canal.

La., Port Allen—COMMUNITY CENTER—See "Waterworks."

Mass., New Bedford—WHARF—City, P. Buildings Dpt., plans repairing Wharf Pier 3, $35,000. G. H. Nye, Municipal Bldg., engr.

Mich., Escanaba—ORE DOCK REPAIRS—Escanaba Iron Mountain & Western R.R., c/o Chicago Northwestern R.R., Chicago, and 111 Bway., New York, revised plans altering and repairing ore docks. To exceed $30,000.

Mont., Havre—GAS SYSTEM—Election Oct. 21, to vote on Proposals (1) authorizing city council to borrow money or issue bonds to amount $80,000 for constructing natural gas distribution system, and (2) authorizing council to contract for purchase of supply of natural gas. Noted Apr. 27, 1933.

N. J., Kearny—OIL TANKS and BULK PLANT—Seacoast Recovery Co., Jacobus Ave., plans four 4,000 gal. storage tanks and bulk plant to replace fire damage, $28,000 with equipment. **Maturity indefinite.** Architect not appointed.

N. Y., Brooklyn—RECREATION BUILDING—Dpt. Parks, Arsenal Bldg., Central Park, New York, plans by A. Embury, c/o owner, 1 story, 45x54 ft. recreation building, Bedford Ave. and Avenues X and Y. Est. about $28,000.

N. Y., Fulton—GAS SYSTEM—Fulton Fuel & Light Co. plans extending pipe line and distributing system, in town of Schroeppel. **Maturity 1935.** To exceed $17,750.

N. Y., New York—COAL POCKET—Public Coal Service, Inc., 3 West 144th St., plans by A. M. Brothers, 110 West 40th St., 2 story coal pockets, concrete, 5 West 144th St. To exceed $28,000 with equipment.

N. Y., New York—GOLF COURSE, etc.—Dpt. Parks, Arsenal Bldg., Central Park, plans 18 hole golf course, 2 story club house, lockers, retaining wall, etc., Pelham Park. To exceed $30,000. Excavation begun by day labor.

N. Y., Syracuse—AIRPORT IMPROVEMENT—City, W. A. Barry, comr., hard surfaced runways at municipal air port, Amboy, $40,000 or more. TERA project disapproved, but city will prepare new set of plans for drainage and hard surface work and re-submit early in 1935.

North Carolina—INDUSTRIAL RAILROAD CROSSING—L. W. Parrish, Richmond, Va., receiver, Richmond Cedar Wks., Richmond, Va., plans 3 mi. logging railroad across Frying Pan Rd., in Tyrrell Co., at point 3.1 mi. east of its intersection with State Hy. 94.

O., Cleveland—CEMETERY, etc.—Sunset Memorial Park, E. H. Komlos, pres., 330 Williamson Bldg., sketches by Steffens & Fox, 1940 East 6th St., brick, stone, steel cemetery, administration, chapel and tower, plain found., Columbia Rd. $200,000.

O., Conneaut—LANDSCAPING—See "Waterworks."

Okla., Chickasha—SWIMMING POOL—City election Nov. 6, $25,000, swimming pool. J. Dubose, city engr. Noted Aug. 23.

Okla., Oklahoma City—UNDERGROUND DUCT—Southwest Bell Telephone Co., Oklahoma City, preliminary plans completed 27 mi. 6 duct underground system from Oklahoma City to El Reno, $250,000; made final plans 6 duct underground system on West 23rd St. from Classen to Villa Sts., in Oklahoma City, $27,000. Private plans.

S. D., Brookings—SWIMMING POOL, etc.—City returned bids to have been opened Sept. 17, for swimming pool and bathhouse, $28,000. Project halted pending court hearing. H. S. Carter, Brookings, engr. Perkins & McWayne, 322 Paulton Blk., Sioux Falls, archts. Noted Sept. 13.

Tenn., Memphis—ELECTRIC POWER LINE—City, election Nov. 6, on proposal to issue not more than $9,000,000 bonds, to purchase existing electric power distributing system or to build competing facilities. Noted Sept. 28, 1933.

Tex., Dallas—CENTENNIAL—City, election Oct. 30, $3,000,000 for centennial. Noted Sept. 27.

Ontario—RAILWAY—Jackson Manion Mines Ltd. plans 43 mi. railway from Gold Lake to Red Lake fields.

Ont., London—GAS SYSTEM—City Gas Co., W. Duffield, genl. mgr., plans election Dec. 3 changing its system and extending mains to supply city with natural gas instead of artificial, $1,000,000.

BIDS ASKED

N. Y., Brooklyn—D.C. CONNECTIONS and TRACK BONDING—Oct. 23, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., New York, furnishing, installing d.c. connections and track bonding for part of Independent and owned Rapid Transit R.R., extending from Rockaway Ave. to Court St. and from South Oxford to Smith Sts.

N. C., Fayetteville—DOCK, etc.—Oct. 10, by S. W. Tomlinson, city clk., dock and wharf complete on Cape Fear River; fabricating, delivering and erecting full circle revolving crane, $87,500. W. F. Schulz, 870 Shrine Bldg., Memphis, Tenn., engr. Noted July 19.

Ont., London—RAILROAD STATION—Oct. 15, by Canadian National R.R. Co., C. Z. Gzowski, ch. engr., Montreal, Que., waiting rooms and concourse, $200,000. T. J. Irving, engr. Noted Sept. 6.

†T. H., Pearl Harbor—SEAPLANE HANGAR—Nov. 14, by Yards & Docks, Navy Dpt., Wash., D. C., seaplane hangar at Naval Fleet Air Base, Spec. 7770.

CONTRACTS AWARDED

California—PIPE LINE—Standard Oil Co. of California, 2225 Bush St., San Francisco, furnishing 1,600 tons 16- to 22-in. steel pipe for pipe line from Kettleman Hills to Estero Bay, near Bakersfield, to National Tube Co., 71 Broadway, New York; 750 tons 12½ in. pipe, to Pittsburgh Steel Co., Union Trust Bldg., Pittsburgh, Pa. Noted Aug. 30.

†Me., Thomaston—BEACON—Superintendent Lighthouses 1st Dist., 150 Federal Bldg., Portland, rebuilding St. Georges Beacon, in St. Georges River, to W. R. Farrell, 37 Long Wharf, Boston, Mass., $2,000. Awarded Oct. 1. Noted Aug. 9.

Mo., St. Louis—FIRE ALARM SYSTEM—Bd. P. Service, City Hall, furnishing, installing fire alarm system in municipal auditorium and community center, to S. C. Sachs, Inc., 817 North 9th St., $715. **P.W.A.** Bids Sept. 25. Noted Sept. 13.

New York—TUNNEL—**Port of New York Authority, 111 8th Ave., New York**, demolishing and removing buildings on site New York approach of Midtown Hudson Tunnel between Weehawken, N. J., and Manhattan Boro., N. Y., to G. Schor, 1569 48th St., Brooklyn, $33,923. Bids Aug. 31. Noted Aug. 23.

N. Y., New York—PIER—Dpt. Docks, Pier A, foot Battery Pl., North River, constructing Pier New 32, North River, to Kenny Bros., 308 Dykman St., $689,000. Contractor awarded structural steel to Jones & Laughlin Steel Co., 3rd Ave. and Ross St., Pittsburgh, Pa.; steel erecting, to Taylor-Fichker Steel Co., 570 7th Ave. **P.W.A.** Bids Sept. 5. Noted Aug. 23.

Ont., Cobden—POWER TRANSMISSION LINE—Hydro-Electric Power Comn., University Ave., Toronto, erecting transmission line from Renfrew to here, by Northcote and Farr line through Bramley Twp. with line to Douglas, $26,000. Owner builds.

MATERIALS AND EQUIPMENT

PROPOSED WORK

MOTOR FIRE FIGHTING APPARATUS—Irvington, Calif.—Irvington County Fire Protection Dist., proposal to form district for which election was held, has been defeated. Plans another election at later date. Noted Aug. 30.

DIESEL POWER PLANT—Tracy, Calif.—City Council to secure estimates of cost of substituting Diesel power for electric motors to operate pumps of municipal water plant and to generate electricity for street lighting.

PUMPER-HOSE TRUCK—Pueblo, Colo.—City, G. W. Clark, clk., G. Stumpf, comr. Fire Dpt., plans purchasing 750 gal. pumper-hose truck early in 1935.

STORAGE TANKS—St. Louis, Mo.—T. J. Ryan, Inc., 4215 Natural Bridge Ave., applied for permit to install three 3,000 gal. and one 560 gal. gasoline storage tanks, pumps, etc., for filling station, 4215 Natural Bridge Ave.

†Federal Government.

Materials, etc. (Continued)

TANKS—**St. Louis, Mo.**—Bell Service Station, 1108 Collins St., applied for permit to install one 12,000 gal. gasoline storage tank, 1108 Collins St.

TANKS—**St. Louis, Mo.**—F. Carbonetti, 5301 Donovan Ave., wants permit to install one 1,000 gal. and one 500 gal. underground steel tanks for gasoline at 3323 South Kingshighway Blvd.

TANKS—**St. Louis, Mo.**—Central States Oil Co., 2720 North Newstead Ave., granted permit to install one 1,000 gal. and one 500 gal. underground tanks for gasoline, pumps, at filling station, 2720 North Newstead Ave.

TANKS—**St. Louis, Mo.**—Glueck Realty Co., 720 Delmar Blvd., granted permit to install three 500 gal. underground tanks for gasoline, at 720 Delmar Blvd.

TANKS—**St. Louis, Mo.**—L. Hilf, 5120 Hampton Ave., granted permit to install three 550 gal. underground tanks for gasoline, pumps, etc., in filling station, 5120 Hampton Ave.

TANKS—**St. Louis, Mo.**—A. H. Nolte, 6120 Sherry Ave., applied for permit to install two 1,000 gal. underground tanks for gasoline at 903 Branch St.

TANKS, etc.—**St. Louis, Mo.**—S. Recht, 6700 Southwest Ave., granted permit to install two 500 gal. gasoline underground tanks and pumps at 6700 Southwest Ave.

TANKS—**St. Louis, Mo.**—Square Deal Oil Co., 6339 Easton Ave., applied for permit to install two 1,000 gal. and one 500 gal. underground tanks for gasoline at 1628-30 Locust St.

TANKS, etc.—**St. Louis, Mo.**—Anna M. Wagner, 2701 Mills St., granted permit to install three 500 gal. gasoline storage tanks, pumps, etc., in filling station, at 2701 Mills St.

ELECTRICAL EQUIPMENT—**Linton, Ind.**—Antioch Power Co. plans installing 6,000 kw. electrical equipment. $46,000.

FIRE EQUIPMENT—**Digby, N. S.**—Town, A. Boden, clk., interested in prices of fire fighting equipment.

LIGHT and POWER EQUIPMENT—**Cornwall, Ont.**—Stormont Electric Light & Power Co., plans early purchase of new equipment. $75,000.

BIDS ASKED

SEWER MATERIALS—**Gustine, Calif.**—City Council, W. L. Chappell, city clk., taking bids furnishing materials and constructing industrial sewer, incl. 2,444 ft. 18 in. and 724 ft. 14 in. concrete irrigation pipe, manholes, etc.

CAST IRON PIPE, etc.—**Oakland, Calif.**—City Port Comn., taking bids 1,500 ft. 8 in. and 800 ft. 6 in. Class "C" c.i. pipe, elbows, fittings, etc., for water line in dock area.

POWER SCARIFIER, etc.—**Redwood City, Calif.**—E. H. Werder, purch. agt. San Mateo Co., taking bids 1 power scarifier, hydraulically operated, bulldozer or bomb, bulldozer trailbuilder, 2 cu.yd. hyd. scraper, incl. pump unit, control lever and valve, 1 hyd. scraper incl. hyd. pump unit, control valve and lever, hose and connections and 1 power-driven broom complete with power take-off.

†GENERATORS—**San Francisco, Calif.**—Contracting Officer, 9th Corps. Area, Presidio, taking bids 1 gasoline driven generator for Fort Miley.

†MOTORS—**Wash., D. C.**—Oct. 26, by Treas. Dpt. at office Sup. Archt., Wash., D. C., small motors in Agriculture Extensible Building.

†TANKS, etc.—**Hingham, Mass.**—Oct. 23, by U. S. Eng., Boston Navy Yard, Boston, insulating 2 elevated water tanks, addition to building, oil burning equipment, hot water heating boiler, circulating pumps, heat exchangers, oil tank, transformers, switches and wiring, etc. Spec. 7750.

†STONE—**Montana**—Oct. 29, by U. S. Eng., 707 Postal Telegraph Bldg., Kansas City, Mo., 100,000 cu.yd. stone for crushing to be placed in stockpiles, stone to be solid, heavy and durable, for Fort Peck Dam. $100,000.

CHASSIS—**Tonopah, Nev.**—Oct. 20, by C. L. Slavin, clk. Nye Co., 1 truck chassis with 6,000 lb. capacity, net; dual tires, with or without 3 yd. body, with horizontal hydraulic hoist.

†WIRE—**Brooklyn, N. Y.**—Oct. 22, by Signal Supply Officer, Army Base, 58th St. and 1st Ave., 900,000 ft. wire.

BLADES—**Raleigh, N. C.**—Oct. 16, by Div. Purchase & Constr., A. S. Brower, dir., 300 five ft. right, 300 five ft. left and 350 eight ft. road machine blades.

†GANTRY CRANE—**Knoxville, Tenn.**—Oct. 25, by Tennessee Valley Authority, furnishing, fabricating, shop painting and delivering one 85 ton gantry crane for Wheeler Power Plant.

†*Federal Government.*

TANKS—**Montreal, Que.**—Mrs. A. D. Maclier, 965 Bleury St., in market for three 1,000 gal. gasoline tanks.

†WINCHES—**Summit, Canal Zone**—Yards & Docks, Navy Dpt., Wash., D. C., taking bids motor and hand operated winches. Spec. 7800. (Date not set.)

CONTRACTS AWARDED

CAST IRON PIPE—**Eureka, Calif.**—City, furnishing 100 tons 8 in. c.i. pipe, to U. S. Pipe & Fdry. Co., Monadnock Bldg., San Francisco, $5,600. Awarded Sept. 26.

DISTRIBUTION TRANSFORMERS—**Los Angeles, Calif.**—D. P. Nicklin, purch. agt. Dpt. Water & Power, 207 South Bway., furnishing, delivering three 500 kva. distribution transformers, f.o.b. cars Los Angeles, Spec. 1495, to Moloney Electric Co., I. W. Kellman Bldg., $5,325. Bids Sept. 20, awarded Oct. 2.

PIPE — **Los Angeles, Calif.** — Metropolitan Water Dist., 306 West 3rd St., S. A. Joseph, purch. agt., 10,000 ft. pipe 22 in. ID, fabricated from 14 ga. black sheet steel, all joints welded, 1 end each length to have parallel 3 in. bell, and other end plain for slip-joint 30 ft. lengths. Bid 27957, to American Pipe & Steel Co., Alhambra, $7,308. Awarded Sept. 25.

STEEL TELESCOPING FORMS, etc.—**Los Angeles, Calif.**—Metropolitan Water Dist., 306 West 3rd St., 166 ft. or more movable steel telescoping forms and accompanying travel for lination with Colorado River Aqueduct, to Blaw-Knox & Western Pipe Corp., 5717 Santa Fe Ave., $16,250 plus. Bids Aug. 31, awarded Sept. 28.

SWITCHES—**Los Angeles, Calif.**—D. P. Nicklin, purch. agt. Dpt. Water & Power, 207 South Bway., furnishing, delivering sixteen 287,000 V. 1200 Amp. 3 pole outdoor type motor gang operated disconnecting switches, vert. break type, for horizontal mounting with or without insulators, incl. spare parts, f.o.b. cars Victorville, Spec. 1484, to Delta Star Electric Co., 415 Wall St., $140,889. Bids Aug. 30, awarded Oct. 2. Noted Aug. 22.

PIPE—**Santa Monica, Calif.**—City, 2,500 ft. 4 in. and 10,000 ft. 6 in. c.i. water pipe, to American Cast Iron Pipe Co., 412 West 6th St., Los Angeles, $7,913. Bids Sept. 14.

AIR COMPRESSOR—**Chicago, Ill.**—Dpt. P. Wks., City Hall, 1 vertical single action, 2 cylinder 15 ton ammonia air compressor, to Burge Ice Machine Co., Railway Exch. Bldg., $2,592. Bids Aug. 15, awarded Oct. 19.

ENAMELED STREET SIGNS—**Chicago, Ill.**—Dpt., P. Wks., City Hall, 46,000 steel enamel street signs, to Day-Brite Reflector Co., Grand Rapids, Mich., $14,730. Bids July 3.

WIRE FENCE—**Chicago, Ill.**—Dpt. P. Wks., City Hall, fabricating, erecting woven wire fence and gates at Wabansia and Avers Aves., to Lane Stewart Fence Co., 111 West Washington St., $634. Bids Aug. 10.

COARSE AGGREGATE, etc. — **Minneapolis, Minn.**—City, 6,400 tons coarse and 3,150 tons fine aggregate, to Aggregate Sales Assn., 610 Baker Bldg., $1.35 per ton and 70c. per ton respectively less 5% off for cash (truck delivered)•••7,800 bbl. portland cement, to Twin City Brick Co., 529 2nd Ave. S., to Builders Supply Co., 721 Lumber Exch., to L. W. Northfield Co., 2542 Central Ave., to Landers-Morrison-Christenson Co., 800 Builders Exch., and to Erde Swanson Bros. Co., 115 Colfax Ave. N., at $2.75 per bbl. f.o.b. cars, carload lots and $2.90 per bbl. truck delivered, sacks included in each case and 5% discount for cash, all above material for Sewer Dpt. Bids Sept. 14.

STEEL — **Minneapolis, Minn.** — City, F. S. Gram, purch. agt., 45,053 lb. billet steel for Sewer Dpt., to Hustad Co., 529 South 7th St., Minneapolis, $1,319; 56,036 lb., to Kalman Steel Co., 848 Builders Exch. Bldg., $1,667. Bids Sept. 17.

†STRUCTURAL STEEL ANGLES, etc.—**Vicksburg, Miss.**—U. S. Eng., to Jones & Laughlin Steel Corp., P. O. Box 66, New Orleans, La., 105,744 lb. structural steel angles $1,746; 60,140 lb. structural steel channels, $963, both net, plus freight; 69,765 lb. mild steel bands and flats and 14,300 lb. mild steel bars, $1,423 plus freight; 63,067 lb. structural steel plates $1,078, net plus freight, shipping point Pittsburgh, Pa. Grand total $5,170. Bids Aug. 28. Noted Aug. 23.

PIPE—**Mount Vernon, N. Y.**—Municipality, 100 tons or more 10 in. and less c.i. pipe, to Warren Fdry. & Pipe Co., Phillipsburg, N. J.

POWER EQUIPMENT—**New York, N. Y.**—Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., furnishing, installing power equipment in Houston Street Line, to Allis Chalmers Mfg. Co., 50 Church St., $559,670. Bids July 24. Noted July 5.

†TRAVELING CRANES—**Fort Bragg, N. C.**—Con. Q.M., hand power traveling cranes, to Morris Bros., Phila., Pa., $2,202. Bids Sept. 27. Noted Sept. 20 Daily.

REFRIGERATION MACHINERY, etc. — **Raleigh, N. C.**—See "Public Buildings."

CAST IRON PIPE—**Huron, S. D.**—City, 15,300 lin.ft. 16 in. c.i. watermain, to U. S. Cast Iron Pipe & Fdry. Co., 122 South Michigan Ave., Chicago, Ill., at $2.17 per ft. Total $33,201. Bids Sept. 10. Noted Sept. 6, under "Waterworks."

PIPE—**Appleton, Wis.**—Water Comn., furnishing 500 ft. 8 in. and 2,400 ft. 6 in. c.i. pipe, to J. B. Clow & Sons, 201 North Talman Ave., Chicago, Ill., at $1.16 and 736 per ft. respectively. Bids Sept. 17.

FOREIGN

Albania and Yugoslavia—Corporation, c/o Minister of Commerce, Albanian Govt., Tirana, Albania, constructing railroad from vicinity Scutari, Albania to Uskub, Yugoslavia, separate contracts awarded.

Asia—Commissariat of Light Industry, Soviet Government, Moscow, or c/o Amtorg Trading Corp., 261 5th Ave., New York, knitting works, 12,000,000 pairs stockings annual capacity, by day labor. $500,000 or more.

Cuba—Sigua Manganese Corp., c/o W. Albans, vice pres., Hoglum, plans developing manganese mining properties, at various locations. To exceed $100,000.

Egypt—Nov. 15, by Ministry of P. Wks., **Cairo,** supplying and delivering three 4 stroke solid injection vertical diesel engines, accessories, three 220 volt 3 phase 60 cycle direct coupled alternators, exciter, cables switchgear at **Gordon's Tree Dockyard**•••Nov. 17, by Ministry of Interior, **Cairo,** cables, transformers, insulators, camp standards for Cheb u el Kanater, in connection with overhead and underground networks•••Nov. 20, by Sudan Irrigation Dpt., **Khartum,** supplying and erecting steel shed, 75 ft. long built up in uniform bays of 17 ft. span 35 ft. height 15 ft.•••Nov. 29, by Sudan Irrigation Dpt., **Khartum,** steel shed 18 meters long, 10 meter span, at main stanchion centers and steel frame building with gable ends 19.5 meters long with 8 meter span at stanchion at centers•••Dec. 3, cylindrical mild steel tank to hold 250 tons fuel oil with pipes, valves and fittings•••Nov. 1, by Ministry Pub. Wks., **Cairo, Sallum**•••Nov. 10, by Ministry of Interior, **Cairo,** transformers, switchgear, cables, for renewal and extension of distribution system at **Manfalout** •••Oct. 15, by Sudan Irrigation Dpt., **Khartum,** 3.4 in black drawn steel conduit, soft drawn copper wire, tinned stranded soft draw copper wire.

England—Nov. 1, by **Stockport** City Engineer, supplying, erecting, operating for 12 months of pressure filters, and auxiliary plant in Goyt Valley•••**Chester-Le-Street** Town Council soon takes bids constructing 910 houses, $1,475,000•••Essex Standing Joint Comn., **Billericay,** voted $820,000 for court house••• North Riding County Council, **Askham Bryan,** erecting institution buildings, $440,000••• Stock, Page & Stock, archts., 18 South Thomas St., **London,** preparing plans hospital, for Bentry Colony, $500,000.

England, London—Chinese Purchasing Comn. in market for supply of 10,000 and 30,000 gal. steel water tanks, duplex pumps, bituminous paint, linseed oil, red oxide, drawing instruments, and 100 tons steel reinforcing bars. Specifications from Fox & Mayo, 155 Dashwood House, Old Broad St., and details at nearest Consulate.

England—H. Lidstet making plans erecting 327 houses, **Hereford,** $500,000•••I. Hill & Son making plans erecting 400 houses, **Pendleton,** $560,000•••**Stockton-on-Tees** Town Council awarded contract 336 houses to George Ford & Son, Stockton-on-Tees, $502,650.

England, Manby—Air Ministry plans constructing Aerodrome and buildings, $600,000.

Irish Free State—Cork Council authorizes plans for constructing 2,000 houses to cost $2,500,000•••**Dublin** Council votes $1,305,000 for housing construction at North Lots.

Isle of Man, Douglas—Nov. 1, by City Electrical Engineer, one 3,750 kw. turbo alternator and one 40,000 lb. water tube boiler.

New Zealand, Wellington—Nov. 5, by Posts & Telegraph Branch, 4 small gasoline driven generator sets.

Siam, Bangkok—Dec. 18, by Royal State Railways of Siam, supplying and erecting several steel bridges. Further details at nearest Legation or Consulate.

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Foreign (Continued)

South Africa—South African Railways & Harbors Administration, Johannesburg, making plans erecting pre-cooling storage plant at **Table Bay** $1,400,000•••Oct. 25, by **Johannesburg** City Engineer erecting extension to gas works, comprising addition to retorts to carbonize 100 tons per day•••Nov. 19, by T. H. Watermeyer, South African Railway & Harbors Administration, **Johannesburg**, pre-cooling plant at **East London**, $1,000,000.

Union Socialist Soviet Republics — Commissariat of Light Industry, Soviet Government, Moscow, or c/o Amtorg Trading Corp., 261 5th Ave., New York, constructing bamboo plant, to manufacture furniture, radio masts, umbrellas, sporting goods, artists materials, at Chakevinsk State Farm, vicinity of Batum, by day labor. $500,000.

Union Socialist Soviet Republics — Commissariat of Heavy Industry, Moscow, or c/o Amtorg Trading Co., 261 5th Ave., New York, plant to produce 26,000 tons metallic aluminum, 18,000 tons alumina, and large cement plant, auxiliary to same, in Kamensk, Central Urals Region, by day labor. To exceed $5,000,000.

Union Socialist Soviet Republic — Commissariat of Heavy Industry, Moscow, or c/o Amtorg Trading Corp., 251 5th Ave., New York, plans automobile plant, 40,000 five and eight ton trucks annual capacity, near Samara. To exceed $1,000,000. Site selected.

Union Socialist Soviet Republic—Dpt. Musical Instruments under Commissariat of Light Industry, c/o Amtorg Trading Corp., 261 5th Ave., New York, piano plant at Tiflis, by day labor. To exceed $500,000.

DETAILS OF PWA NON-FEDERAL ALLOTMENTS

Loans and Grants Except as Noted.

*Grant. †Loan.

KEY TO SYMBOLS

m-meters	**c**-canal
p-pump	**dm**-dam
t-tank or standpipe	**r**-reservoir
f-filtration	**t**-treatment plant
d-distr. supt.	**b**-building
w-well	**I**-iron removal
s-supply	**pw**-power line
g-generator	**sf**-softening
ch-chlorinators	**bl**-boilers

Water Works

Adams County, Ohio, **w-p-t-d-**	$41,000
Berry, Ala., **w-p-t-d-**	35,000
Carbondale, Colo., **s-d**	40,000
Christopher, Ill., **f-o-s-**	52,000
Doylestown, Ohio, **w-p-t-d**	54,000
Fayette, Ohio, **w-p-t-d**	60,000
Lynchburg, Ohio, **p-d** and repairs	20,000
Mountainair, N. Mex., **2r-d**	75,000
Port Allen, La., **w-s-d**	21,000
Smithfield, Ohio, **w-p-t-d**	60,000
Westmont, Ill., **w-p-d**	30,000
Martin, S. Dak., **w-p-t-d**	37,000
Mt. Vernon, Ga., **w-p-t-d**	26,000
Spencer, S. Dak.	32,000
Statesville, N. Car., **r-p-f-d**	60,000
Watford, N. Dak., **w-p-t-d**	28,000

Sewers & Disposal Plants

Dumas, Ark.	42,000
Star City, Ark.	21,000
•Preble, Wis.	13,000
•Batesville, Ind	40,000

Street or Road Const.

Miles City, Mont.	46,000
Miles City, Mont.	92,800
•State of Illinois (also 2 grade separations)	522,500
Miles City, Mont.	4,000

Buildings

Cattaraugus Co., Machias, N. Y., (County home)	174,000
Donaldsville, La. (City Hall, Bath House & repairs)	16,500
•Harrison Co., Iowa (County Home)	2,100
New York, N. Y. (Sea View Hospital)	241,000
West Baton Rouge Parish, Port Allen, La. (Community Center)	39,900
State of South Carolina (Improvements to institutions)	976,000
Wayne County, Mich. (hospital)	1,050,000

Schools

Callahan, Fla.	55,000
Cameron County, Tex.	25,000
•Carson County, Tex.	5,800
Crossville, Tenn.	2,500
•Cumberland, Md.	205,000
Duluth, Minn. (Grand stands and flood lighting)	23,800
Florence County, S. C.	12,000
•Montgomery Co., Ohio	30,800
New York, N. Y. (No. 210, Brooklyn)	257,000
Normal, McLean County, Ill.	33,700
•Post, Tex.	3,400
Arizona State Teachers' College, Tempe, Ariz.	455,000
East Texas State Teachers' College Commerce, Tex. (Dormitory)	106,500
Miami Beach, Fla.	700,000
Minford, Ohio	125,700
Monroeville, Ohio	120,000
New York, N. Y.	246,000
New York, N. Y.	301,700
New York, N. Y.	630,000
Pen Argyl, Pa.	162,000
Smethport, Pa.	55,000

Miscellaneous

New York, N. Y. (Kings County Hospital)	231,000

PUBLIC BUILDINGS

PROPOSED WORK

†Ariz., Naco — Treas. Dpt. at office Sup. Archt., Wash., D. C., plans customs immigration inspection station.

Ark., Brinkley—See "Sewerage and Waste Disposal."

Calif., Berkeley—Berkeley City High School Dist. election Nov. 6, $677,000, for additional units for high school groups, new shops, auditorium.

Calif., Fresno—State plans by G. B. McDougall, state archt., P. Wks. Bldg., Sacramento, rein.-con. administration building, State Teachers Ground. $200,000.

Calif., Fresno—State plans by G. B. McDougall, state archt., P. Wks. Bldg., Sacramento, rein.-con. gymnasium, State Teachers Ground. $160,000.

Calif., Los Angeles—Bd. Educ. have taken out building permit and plans by S. A. Lunden, 400 Rowan Bldg., reconstructing James A. Foshay Jr. High School, 3 story, consisting of brick main building, shop building, rebuilding walls with concrete and gunite, adding wall and roof anchors and bracing, etc., 3751 South Harvard Blvd. $178,000. L. J. Waller, 257 South Berendo St., engr. Noted Mar. 22.

Calif., Los Angeles—Bd. Educ. have taken out building permit and plans by Austin & Ashley, Chamber of Commerce Bldg., 2 story, 81x151 ft., 64x223 ft., and 64x249 ft. concrete administration, junior and senior buildings for Venice High School, 13000 Venice Blvd. $375,000.

Calif., Los Angeles—Bd. Educ. plans by S. O. Clements, 1135 Van Nuys Bldg., new 45 unit classroom and cafeteria for Thomas Jefferson High School. $353,000. P.W.A. project. Noted Feb. 2.

Calif., Los Angeles—Bd. Supervs. Los Angeles Co. rejected bids Aug. 13, for infirmary units and connecting arcades at Los Angeles Co. Farm, Rancho Los Amigos. W. Davidson, co. mechanical engr. instructed to revise plans for 2 new units instead of 3. Noted Aug. 23, under "Contracts Awarded."

Calif., Pasadena—Pasadena City High School Dist., election Oct. 26, $375,000, to finance reconstruction of George Washington Junior High School, $200,000; Pasadena Junior College, $115,000, and Marshall Junior High and McKinley Junior Schools, $60,000.

Calif., Pasadena—Pasadena Bd. Educ. plans by C. Bennett, 311 1st Trust Bldg., rebuilding school buildings at Pasadena Junior College, $115,000; plans by F. Kennedy, Jr., 4041 East Green St., rebuilding George Washington Junior High School, $200,000.

Calif., San Francisco—City and San [illegible] Co. plans by W. Mooser, Monadnock Bldg., and E. A. Eames, 333 Sacramento St., [illegible] school, Kirkham St. and 42nd Ave. [illegible] or more.

Calif., San Francisco—City and San [illegible] Co. plans by W. D. Peugh, 333 Montgomery St., and G. A. Dailey, 210 Post St., fireproof [illegible] $150,000 or more. Leland & Haley, 5[illegible] St., San Francisco, mechanical engr. W. [illegible] 1 Montgomery St., structural engr.

Calif., San Francisco—City and San [illegible] cisco Co., plans by H. A. Minton, 525 Market St., complete restoration Class A. brick con., steel school, destroyed by fire during construction, Geary and Scott Sts. To exceed $150,000. Noted Sept. 13.

Calif., San Quentin—State plans by [illegible] McDougall, state archt., P. Wks. Bldg., Sacramento, dormitory, State Penitentiary [illegible] $150,000. Work will probably be done by prison labor. Noted May 10.

Calif., Santa Barbara—City, election Oct. 30, $320,000, for civic auditorium. P.W.A. [illegible] allocated $375,000 for project. Associated Architects, 116 East Sola St., archts. Noted Aug. 9.

Calif., Santa Monica — Bd. Educ. [illegible] drawings by Marsh, Smith & Powell, 510 Architects Bldg., Los Angeles, for new school building on John Adams High School site on [illegible] Park Blvd. and 6th St. $125,000.

†Colo., Pueblo—Treas. Dpt. at office Supv. Archt., Wash., D. C., survey and plans completed by J. S. Elliott, constr. engr., rebuilding 3 story, stone post office and 2 story annex, 3rd and Main Sts. $170,000. Noted Aug. 9.

Conn., Norwich—State Hospital for Insane plans brick, steel dormitory unit. $195,000. Architect not appointed.

Fla., Miami—City plans by G. L. Pfeiffer, 2 South East 1st Ave., addition to Jackson Memorial Hospital, incl. 6 story building for private patients and administrative offices, new kitchens and dining rooms and addition to nurses home. Noted Mar. 1.

Fla., Miami Beach—City appointed A. Geiger, supervg. archt., 733 Lincoln Rd., for school building program. P.W.A. approved $700,000 bond issue. Noted June 28.

†Ill., Chicago—U. S. Coast Guard, Treas. Dpt. Annex 1, Wash., D. C., plans construction lighthouse at mouth of Chicago River. $75,000. D. K. Robinson, 452 Federal Bldg., Milwaukee, Wis., engr.

Ill., Wheaton—DuPage Co., N. W. Liss, [illegible] election Oct. 15, 3 and 4 story, basement, 90x120 ft., rein.-con., brick, steel, court house, Willow St. P.W.A. allotted $751,600. Royer, Danely & Smith, 301 West Main St., Urbana, archts.

Ind., Livionia—School Trustees, J. B. Hawkins, New Albany, soon takes bids heating, plumbing and electric fixtures, $17,900. J. B. Hawkins, New Albany, engr.

Ia., Waterloo—City, C. C. Mackay, clk. of aud., City Hall, plans for special election on proposal to erect city hall and auditorium, held up at request of P.W.A. $285,000 allotted by P.W.A.

Kan., Colby—City, new bids in 60 days, 2 story, basement, 152x223 ft., brick, stone high school. $200,000. Former bids rejected. Mayer & Co., 721-22 Rorabaugh Wiley Bldg., Hutchinson, archts. Noted Nov. 30.

†Kan., Fort Scott—Treas. Dpt. at office Supv. Archt., Wash., D. C., revised plans by W. E. Glover, archt., 301 Natl. Reserve Bank Bldg., Topeka, 4 story, basement, 71x111 ft., brick, stone U. S. Post Office. $225,000. Noted Aug. 17.

Ky., Louisville—City Hospital, Dr. H. Leavell, dir. health, to submit plan to Mayor and Board of Aldermen for construction of $250,000 addition building, to be addition to city hospital, Preston and Chestnut Sts. There is sufficient vacant ground adjoining hospital. P.W.A. aid to be applied for. Architect not appointed.

Me., Pownal—Pownal State School, S. F. Vosburgh, supt., plans by H. S. Coombs, Lisbon St., Lewiston, 1 story, laundry addition, $20,000; heating plant alterations and equipment, $17,000; 2 story school building, $60,000; addition to nurses home, $40,000; 3 cottages for employees, $18,000; 3 story, basement, male dormitory, $155,000; and 3 story, basement, female dormitory, $155,000, brick, steel, stone and granite construction. Fels Co., 42 Union St., Portland, engrs.

†Mass., Turners Falls—Treas. Dpt. at office Sup. Archt., Wash., D. C., rejected bids Aug. 31, post office, 6th St. and A Ave. Noted Aug. 9.

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†*Federal Government*

Public Buildings (Continued)

Minn., Minneapolis—State, E. A. Walsh, adjutant general, 10 State Capitol, St. Paul, and City, c/o Armory Comn., City Hall, plans by P. C. Bettenburg, assoc. archt., Little Falls, and takes bids within 100 days. 240x300 ft., basement, rein.-con., brick, stone armory, 95 ft. high, 5th St. and 5th Ave. S. $640,000. Noted Aug. 6.

Minn., North Mankato—City, E. M. Charles, clk., making plans constructing municipal electric light and power plant, incl. 45x82 ft. power house, distribution system. G. M. Orr & Co., 408 Baker Bldg., Minneapolis, engrs. Wick & Stansfield, North Mankato, archts.

Mo., St. Louis—Bd. P. Serv., City Hall, rejected bids Sept. 14, fabricating, painting and installing 2 elevator cabs, on platforms and slings furnished by others and appurtenances thereto in North Ward Building of Homer G. Phillips City Hospital for Colored, Whittier St. between St. Ferdinand and Kennerly Aves. $1,300. W. C. E. Becker, 301 City Hall, engr.

†**Mo., Perryville**—Treas. Dpt. at office Sup. Archt., Wash., D. C., rejected bids Sept. 19, 1 story, basement, 150x200 ft., U. S. Post Office, East Ste. Marie and Spring Sts. $37,700. Noted Sept. 13.

N. H., Durham—University of New Hampshire, E. M. Lewis, pres., indefinitely postponed construction gymnasium, auditorium and stadium. $150,000. E. T. Huddleston, Durham, archt. Noted Jan. 19.

N. J., Chatham—Bd. Educ. plans by W. A. Pieper, Chatham, high school. $386,000. P.W.A. funds allotted.

N. J., Wayne—Bd. Educ. Wayne Twp. plans by Hacker & Hacker, Main St., Fort Lee, school. $300,000. P.W.A. funds allotted.

N. Y., Albany—City bids about Oct. 15, converting old Albany Academy building into office building. $105,000. P.W.A. project. M. T. Reynolds, 100 State St., Albany, archt. Noted June 28.

N. Y., Altmar—Village sketches made by Wright & Ellis, 108 West Fayette St., Syracuse, 2 story, basement, brick, steel grade and high school, plain found. $125,000.

N. Y., Andes—Bd. Educ. plans by H. O. Fullerton, 111 State St., Albany, and soon takes bids school. $142,500. P.W.A. funds allotted.

N. Y., Bellmore—School Districts of Merrick, North Merrick, Bellmore and North Bellmore, voted to establish central high school. $675,000.

N. Y., Bellport—Bd. Educ. plans enlarging school facilities. $125,000.

N. Y., Colesville—Bd. Educ. soon takes bids general contract Harpursville School. $173,000. R. R. Graham, Middletown, archt. P.W.A. funds allotted.

N. Y., Dongan Hills—Dpt. Hospitals, Municipal Bldg., New York, plans by F. DeLancy Robinson, 121 East 37th St., New York, addition to Seaview Hospital, chapel, etc., Brille Ave. Sea View Farm. $241,000. P.W.A. loan allotted.

N. Y., Floral Park—Bd. Educ., Town of Hempstead, defeated bonds constructing high school. $345,000. **Maturity indefinite.** P.W.A. allotment rescinded. Knapp & Morris, 192 Lexington Ave., New York, archts. Noted Sept. 6.

N. Y., Garden City—Bd. Educ., Hempstead, school or high school. $930,000. P.W.A. allotment rescinded. **Maturity indefinite.** G. Nichols, 144 East 30th St., New York, archt. Noted Apr. 5.

N. J., Jackson Heights—Bd. Educ., 500 Park Ave., New York, soon takes bids P. S. 2, 3 story, brick, 21st Ave. and 76th St. $301,700. P.W.A. loan granted. W. C. Martin, Flatbush Ave. Extension and Concord St., Brooklyn, archt. Noted Nov. 19, 1931.

N. Y., Lockport—City Council plans municipal library, Sawyer St., for City Council and Bd. Educ. $132,000. City plans bond issue $23,000 for city's share of cost. Bd. Educ. will use fund of $50,000 towards cost and balance of funds will be furnished by state as TERA project. Noted Mar. 15.

N. Y., Long Island City—Bd. Educ., 500 Park Ave., New York, plans by W. C. Martin, Flatbush Ave. Extension and Concord St., Brooklyn, constructing P. S. 149, 4 story, brick, 94th St. and 34th Ave. $630,000.

N. Y., Malverne—Malverne School Dist. turned down P.W.A. grant and loan of $251,800 for constructing high school addition. Noted Aug. 30.

N. Y., New York—Bd. Educ., 500 Park Ave., soon takes bids constructing 5 story addition to P. S. 80, Mosholu Parkway and Van Courtland Ave., Bronx Boro. $246,000. P.W.A. loan granted. W. C. Martin, Flatbush Ave. Extension and Concord St., Brooklyn, archt.

N. Y., North Hempstead—Bd. Educ., constructing Great Neck High School. $440,000. P.W.A. allotment rescinded. Project in abeyance. Gilbert & Betelle, Chamber of Commerce Bldg., Newark, N. J., archts.

N. Y., Richmond Hill—Bd. Educ., 500 Park Ave., New York, soon takes bids P. S. 48, 3 story, brick, 108th Ave. and 156th St. $384,000. P.W.A. loan granted. W. C. Martin, Flatbush Ave. Extension and Concord St., Brooklyn, archt.

N. Y., Tupper Lake—Village soon takes bids school. $300,000. P.W.A. project. R. Graham, 25 Prospect St., Middletown, archt. Noted July 26.

N. Y., Wilson—School Dist. 1 voted to construct high school. $180,000-$225,000. P.W.A. project. Noted Aug. 2.

O., Dover—City plans improving municipal light and power plant. $330,000. Approved by Engineering Division of P.W.A.

O., Minford—Minford Rural School Dist., Scioto Co., plans school. $125,700. P.W.A. loan and grant approved. De Voss & Donaldson, Portsmouth, archts. Noted May 3.

†**O., Portsmouth**—Treas. Dpt. at office Sup. Archt., Wash., D. C., revising plans for $400,000 U. S. Post Office, here is 60% completed and that contract will be awarded before Dec. 1. Noted Aug. 3, 1933.

Pa., Penn Argyl—School Dist. plans by Jacoby & Everett, Commonwealth Bldg., Allentown, and soon takes bids 2 story, basement, 80x240 ft., brick, steel school, plain found. Est. $165,000. P.W.A. authorized grant. Noted June 28.

R. I., Exeter—State, C. E. Blais, Box 7, Howard, plans being completed by A. J. Murphy, 25 Fenner St., Providence, and takes bids this month 2 story, basement, 55x115 ft. and 15x55 ft. brick, steel dormitory at State School. $180,000.

R. I., Providence—Rhode Island School for Deaf, 520 Hope St., bids early in November, 2 story, brick, steel industrial school and gymnasium. Hope St. $115,000. W. Walker & Son, archts., 49 Weybosset St., completing drawings. Noted Feb. 8.

S. C., Cedar Spring—South Carolina Institute for Deaf and Blind, W. L. Walker, supt., Cedar Spring, plans industrial building, incl. print shop, woodcraft and manual training department, barber shops, shoe shops, mattress and broom shops. $38,000. Building to cost $25,000. P.W.A. allotment. $13,000 endowment for equipment.

S. D., Sioux Falls—Bd. Educ. rejected bids Aug. 27, remodeling and constructing 2 story, basement, brick, steel school addition. $140,000. Will readvertise. Hugill & Blatherwick, 367 Bouce-Greeley Blk., archt. Noted Aug. 16.

Tenn., Chattanooga — University of Chattanooga, A. Guerry, pres., plans dormitory, McCallie St. $150,000. Application for P.W.A. loan and grant made. Architect not appointed.

Tex., Houston—City plans city hall. $1,219,000. Architect not appointed. P.W.A. loan and grant allotted.

†**Tex., Johnson City** — Vet. Bu., Arlington Bldg., Wash., D. C., plans repairing and altering U. S. Veterans Hospital. $395,000.

Tex., Nacogdoches—Stephen F. Austin, State Teachers College, Nacogdoches, plans by W. E. Ketchum, 209 East Milton St., Austin, 3 story, brick, rein.-con., steel dormitory. $123,000 P.W.A. loan and grant approved. Noted Jan. 18.

†**Tex., Pecos** — Treas. Dpt. at office Sup. Archt., Wash., D. C., rejected bids Aug. 28, constructing 2 story, basement, post office. $100,000. Will readvertise. Noted Aug. 9.

†**Wash., Lourier**—Treas. Dpt. at office Sup. Archt., Wash., D. C., plans customs immigration inspection station.

†**Wash., Nespelem**—Indian Bureau of Dpt. Interior, Wash., D. C., plans rein.-con. hospital building on Colville Indian Reservation. $180,000.

Wis., Milwaukee—City plans constructing office building, North Market St., for Water Dpt. $400,000. R. E. Stoelting, comr.

Alta., Calgary—Dpt. National Defence, Ottawa, Ont., plans by W. S. Bates, military barracks. To exceed $1,000,000.

B. C., Vancouver—Dpt. National Defence, Ottawa, Ont., plans by McCarter & Nairne, armory for Seaforth Highlanders Regiment. Est. $200,000.

B. C., Vancouver — Dominion Government, Ottawa, Ont., plans by McCarter & Nairne, Marine Bldg., concrete, steel armory building, plain found., at Kitsilano Indian Reserve. $240,000.

Ont., Guelph—Dpt. P. Wks., Ottawa, Ont., plans by V. Chadwick, Toronto, public building. $200,000.

Que., Montreal—Seventeenth Royal Canadian Duke of York Huzzards, preparing plans cavalry armory and equestrian training school on Cote des Neiges Rd. $300,000. Plans are being prepared under direction of Dept. National Defence, Ottawa, Ont.

BIDS ASKED

†**Calif., Colton**—Nov. 2, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $57,200. Former bids rejected. Noted Aug. 9.

Calif., San Francisco—Oct. 24, by S. J. Hester, secy. Dpt. P. Wks., City Hall, 6 story, cancer building and 5 story psychopathic building, both rein.-con., steel, brick, Potrero Ave. near 22nd St., for City and San Francisco Co. $500,000 or more. Leland & Haley, 58 Sutter St., mechanical engr. H. J. Brunnier, Sharon Bldg., structural engr. Noted June 28.

D. C., Wash.—Oct. 17, by District Commissioners, District Bldg., constructing gymnasium incl. alterations for same to building at Haiti Pl. between Irving St. and Park Rd.

†**Ga., Savannah**—Oct. 24, by Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Quarantine Station.

†**Ill., Glen Ellyn**—Oct. 29, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office.

†**Ill., Wood River**—Oct. 30, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. Noted Mar. 29.

†**Ia., Des Moines**—Nov. 5, by Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Post Office. Noted May 10.

†**Kan., Hays**—Nov. 5, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. Noted Mar. 9, 1933.

†**Ky., Lexington**—Oct. 19, by Treas. Dpt. at office Sup. Archt., Wash., D. C., building and equipment for Narcotic Farm.

†**La., Alexandria**—Nov. 6, by Vet. Bu., Arlington Bldg., Wash., D. C., pump house and pump at U. S. Veterans Administration Facility.

†**Me., Calais**—Oct. 18, by Treas. Dpt. at office Sup. Archt., Wash., D. C., concrete, brick inspection station, near St. Stephens Bridge. $122,400 appropriated.

†**Md., Cambridge**—Oct. 29, by Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Post Office.

†**Mass., Beverly**—Oct. 29, by Treas. Dpt. at office Sup. Archt., Wash., D.C., extending and remodeling U. S. Post Office. Noted Sept. 6.

†**Mass., Boston**—Oct. 16 (extended date), by Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office, elevators and mail handling equipment. Noted Sept. 13, 20 and 27.

Mass., Wayland—Oct. 19, by Town, School Dpt., Wayland, brick, steel high school. $105,000. P.W.A. project. Frank Irving Cooper Corp., 47 Winter St., Boston, archt. Noted May 10.

Mass., Wellesley—Oct. 16, by Town, R. E. Blakeslee, chn. Building Comn., Town Clerk's office, Town Hall, 2 story, basement, irregular sized, brick, stone, high school addition, concrete found., Kingsbury St. $175,000. P.W.A. project. J. Williams Beal Sons, 185 Devonshire St., Boston, archts. Noted Dec. 14.

†**Miss., Meridian**—Oct. 19, by Dpt. Agriculture, Wash., D. C., constructing cold storage fruit and vegetable products building at U. S. Pecan Field Station, near here.

†**Mont., Crow Agency**—Oct. 31, by Bureau Indian Affairs, Wash., D. C., constructing hospital. Noted July 19.

†**Mont., Hamilton**—Nov. 5, by Treas. Dpt. at office Sup. Archt., Wash., D. C., quarters for medical officer and attendants and animal house, 5 buildings (except elevators), U. S. Public Health Service Laboratory. $132,000.

†**N. H., Portsmouth**—Oct. 29, by Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Post Office. $51,000. Noted Aug. 16.

N. J., Bordentown—Oct. 19, by Dpt. Institutions & Agencies, State Office Bldg., Trenton, structural steel, miscellaneous and ornamental iron for prisoners building and power plant, and 150 kw. steam turbine and generator for Prison Farm. $150,000.

†**N. J., Caldwell**—Oct. 22, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $73,700.

†**N. J., Dover**—Nov. 5, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. Noted Dec. 14.

†**N. Y., New York**—Oct. 19, by Treas. Dpt. at office Sup. Archt., Wash., D. C., exterior doors in U. S. Parcel Post Building.

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†*Federal Government.*

Public Buildings (Continued)

†**N. Y., New York**—Oct. 24 (extended date), by Treas. Dpt. at office Sup. Archt., Wash., D. C., federal office building. Noted Sept. 6.

†**N. Y., Roscbank**—Oct. 20, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing new buildings.

N. Y., Wellsville—Oct. 19, by Water & Light Dpt., one 400 hp. boiler, 350 lbs. working pressure, 528 degrees F. total temperature. G. Esherick, Jr., assoc. engr.

†**N. C., Rockingham**—Oct. 30, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office.

†**Okla., Holdenville**—Nov. 5, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. Noted Mar. 8.

Okla., Pawnee—Oct. 24, by City Clerk, furnishing, installing two 450 BHP diesel oil engines with generators, exciters, and auxiliaries, Sect. 1; complete switchboard and electrical equipment and station wiring, Sect. 2; foundations for engines, structural steel, oil storage tank, piping, etc., Sect. 3, in power plant. W. R. Holway, 302 East 18th St., Tulsa, consult. hydraulic engr. Noted July 19.

†**Pa., Emporium**—Oct. 18, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office.

†**Pa., Mount Joy**—Oct. 18, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $43,775.

†**Pa., Nazareth**—Oct. 30, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office.

†**Pa., Phila.**—Yards & Docks, Navy Dpt., Wash., D. C., taking bids constructing buildings for Navy Yard Aircraft Factory, Spec. 7719. (Date not set.) Noted Sept. 27.

†**Pa., Sellersville**—Oct. 29, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $65,000.

†**S. C., York**—Oct. 30, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $44,000.

S. D., Sioux Falls—Oct. 29, by City, A. Norstad, aud., 3 story, basement, 113x130 ft., concrete city hall. $320,000. H. Spitznagel & J. J. Schwartz, 309 Western Surety Bldg., Sioux Falls, archts.

†**Tex., Dalhart**—Oct. 23, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $48,100. Noted Feb. 15.

†**Tex., Kingsville**—Oct. 25, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. $50,000. Noted Sept. 6.

Wash., Seattle—Bd. P. Wks., bids about Oct. 10, constructing Diablo power house, tailrace and appurtenances, for Skagit Hydro-Electric Project. Henrickson-Alstrom Constr. Co., Textile Tower, was awarded contract, but could not secure performance bond, because of error in figuring. Noted Oct. 4, under "Contracts Awarded."

†**Canal Zone**—Nov. 5, by Dpt. Quartermaster, Quarry Heights, at office Con. Q.M., 39 Whitehall St., New York, or at office Con. Q.M., Fort Mason, San Francisco, Calif., constructing parachute armament, radio and photo laboratory building and paint and dope house with utilities and appurtenances, for France Field.

CONTRACTS AWARDED

Calif., Coalinga—Coalinga Union High School Dist., science building and swimming pool, to W. J. Ochs, 714 American Trust Bldg., San Jose, $114,929 and $55,900 respectively. Contract subject to P.W.A. approval.

Calif., Pasadena—Wm. T. Loesch & Son, contractors, 119 East Union Ave., have signed contract for construction of school buildings, consisting of auditorium, primary kindergarten and 2 classrooms, at James A. Garfield elementary school site, for Bd. Educ., $150,864. **P.W.A.** Noted Sept. 27, under "Contracts Awarded."

Ill., Bloomington—Bd. Educ., general contract Sheridan and Lincoln Schools, to J. L. Simmons Co., 917 East Oakland St., $94,550 and $94,700 respectively***plumbing, to E. E. Sendelbach & Son, Bloomington, $5,865 and $5,181 respectively***electrical work, to Gray-Trimble Electric Co., Bloomington, $5,112 and $5,019 respectively***heating for Sheridan School, to Magirl Fdry. & Furnace Co., Bloomington, $9,050***heating for Lincoln School, to American Fdry. & Furnace Co., Bloomington, $9,319. Grand total $229,433. **P.W.A.** Bids Sept. 29. Noted Sept. 13.

Ill., Highland—Bd. Educ. for School Dist. 15, Madison Co., general contract 2 story, 73x73x88x280 ft., brick, rein.-con. high and grade school, incl. auditorium, gynasium and offices, to Kellermann Contr. Co., 625 North Euclid Ave., St. Louis, Mo., approximately $160,000***heating, to Elliott & Barry Eng. Co., 4060 West Pine St., St. Louis, Mo., $29,964 (base bid)***plumbing, to Carson-Payson Co., Danville, $14,177 (base bid)***electrical work, to Vierbeller Electric Co., 1107 Clark Ave., St. Louis, Mo., $13,100 (base bid). Grand total $217,241. Est. $194,000. **P.W.A.** Bids Sept. 4. Noted Aug. 23.

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†**Mass., Boston**—Treas. Dpt. at office Sup. Archt., Wash., D. C., improving operations of passenger elevator, to Westinghouse Elevator Co., 1500 North Branch St., Chicago, Ill., $13,636.

†**Mass., Fairhaven**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to Murch Bros., 4111 Lindell Blvd., St. Louis, Mo., $41,430. Bids Aug. 24. Noted Aug. 9.

Mass., Worcester — City, Superintendent P. Wks., City Hall, general contract 2 story, basement, 114x130 ft. ward building at Belmont Hospital, to M. S. Kelliher Co., 38 Chauncy St., Boston, $174,694***electrical work, to Economy Electric Co., 22 Foster St., $11,693***plumbing, to Tucker & Rice, Inc., 11 Garden St., $19,527***heating and ventilating, to Central Heating Co., 8 Garland St., $16,940. Grand total $222,854. **P.W.A.** Bids Sept. 21, awarded Oct. 3. Noted Sept. 6.

Mo., St. Louis—Kaplan-McGowan Co., general contractors, 315 North 7th St., removing existing structures, to J. A. Schaefer, 7340 Northmoor St.***composition roofing for 2 tiers of solaria at City Sanitarium, 530 Arsenal St., to Certainteed Products Corp., 1531 North 11th St.***glazing, to Nurre Co., 3815 LaClede Ave.***plumbing and drainage, to Moore Plumbing Co., 4466 Finney Ave.***heating and ventilating, to Peters-Eichler Heating Co., 1516 Pine St., for Bd. P. Service, City Hall. Noted Sept. 13, under "Contracts Awarded."

N. J., Sparta—Bd. Educ., general contract 2 story school, to H. Montague & Son, 15 Exchange Pl., Jersey City, $88,900***heating and ventilating, to F. P. Farrell, 269 Camden St., Newark, $17,844***structural steel and ornamentation, to Globe Iron Wks., 168 West 24th St., Bayonne, $5,670***plumbing, to Carlson Babcock, 89 Walnut St., Montclair, $5,595***electrical work, to Watson Flagg Eng. Co., Paterson, $6,391. Grand total $124,400. **P.W.A.** Bids Sept. 29. Noted Sept. 20.

†**N. Y., Brooklyn**—Yards & Docks, Navy Dpt., Wash., D. C., replacing steel sash Building 5, Spec. 7785, to Bellman Constr. Co., 31 Union Sq., New York, $5,472. Bids Sept. 24.

†**N. Y., Carthage**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to W. S. Johnson Building Co., 2532 Hyde Park Blvd., Niagara Falls, $46,990. Bids Sept. 27. Noted Sept. 6.

N. Y., Coxsackie—Dpt. Correction, State Office Bldg., Albany, equipment Div. D, New York State Vocational Institution, to Ruslander & Sons, 214 Terrace St., Buffalo, $19,775; bakery equipment, to Harvey Brett & Co., 129 West 31st St., New York, $12,120. Bids Sept. 5. Noted Aug. 23.

N. Y., Coxsackie—Dpt. Correction, State Office Bldg., Albany, general contract kitchen and gymnasium shop building, at New York State Vocational Institution, to C. B. Saxon, 35 West 45th St., New York, $161,341***heating, to Afgo Eng. Co., 35 West 45th St., New York, $12,443***sanitary work, to A. J. Eckert, 103 North Lake Ave., Albany, $12,706***electrical work, to Hewitt & Warden, 15 Chambers St., Newburgh, $4,237. Grand total $190,721. Bids Aug. 30. Noted Aug. 23.

†**N. Y., Johnson**—Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office, to Arthur Weinstein, 194 South Main St., Wilkes-Barre, Pa., $43,873. Bids Sept. 18, awarded about Sept. 29. Noted Aug. 30.

N. Y., Lawrence—Bd. Educ., general contract high school, to Psaty & Fuhrman, 369 Lexington Ave., New York, $418,000. Subject to P.W.A. approval. **P.W.A.**

N. Y., Oneonta—Dpt. Health, State Office Bldg., Albany, completing sanitary work at hospital for treatment of tuberculosis, to Jarcho Bros., 215 East 37th St., New York, $23,274. Bids Aug. 30. Noted Aug. 23.

N. C., Wake Forest—Wake Forest College, T. Kitchin, pres., auditorium and gymnasium building, to Geo. W. Kane Constr. Co., Durham, $115,000. Noted May 11.

†**O., Bedford**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to Steinle-Wolfe Constr. Co., 1515 Creghan St., Fremont, $41,141. Bids Aug. 24. Noted Aug. 9.

O., Oxford—State Bd. Trustees, general contract altering and constructing 3 story, basement, brick, dormitory addition, to C. L. Knowlton, Bellefontaine, $145,472***plumbing and heating, to Sam A. Esswein Co., 546 East Broad St., Columbus, $20,027 and $20,025 respectively***electrical work, to Frees Electrical Co., 622 Broadway, Cincinnati, $14,080***ventilating, to King Mfg. & Heating Co., Cincinnati, $3,087*** built in refrigeration, to United Cork Co., 824 Reedy St., Cincinnati, $1,725. Grand total $204,416. Bids Aug. 22. **P.W.A.** Noted Aug. 2.

†**Pa., Ebensburg**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to R. W. Erickson, 119 South 4th St., Phila., $38,960. Bids Sept. 21. Noted Sept. 13.

†**R. I., East Greenwich**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to DiSandro Bros., 106 Langdon St., Providence, $42,800. Bids Sept. 19. Noted Sept. 13.

S. D., Sioux Falls—Bd. Educ., general contract altering and constructing 4 story, basement, 180x300 ft., brick, steel, high school addition, to Henry Carlson Co., 407 Minnehaha Blk., $460,135***plumbing, heating, ventilating and temperature control, to Healy Plumbing & Heating Co., 287 West Kellogg Blvd., St. Paul, Minn., $63,186***electrical wiring, to Electric Constr. Co., 322 South Phillips Ave., $36,397. Grand total $559,718. **P.W.A.** Bids Sept. 19. Noted Sept. 13.

†**Va., Norfolk**—Treas. Dpt. at office Sup. Archt., Wash., D. C., water piping for U. S. Marine Hospital, to T. L. Dawson, 2035 Washington St., Kansas City, Mo., $13,000.

†**Wis., Green Bay**—U. S. Eng., Milwaukee, general contract Green Bay Outer Harbor light station, to Waterways Eng. Corp., Green Bay, $54,161.

COMMERCIAL BUILDINGS

PROPOSED WORK

Calif., Los Angeles—Eastern Syndicate plans by G. S. Underwood, 3170 Lake Hollywood Dr., 7 story, basement, Class A apartment, incl. garage, basement, 410 North Rossmore St., $250,000.

Calif., Los Angeles—Gore Bros., 1584 West Washington St., plans by C. A. Balch, 1584 West Washington St., constructing probably Class A theatre building, Beverly-La Brea Dist., $115,000 incl. equipment.

Conn., Middletown—Wesleyan University, 230 High St., A. W. Johnson, supt. buildings, acquired additional land for building program and plans infirmary and college inn, High St. To exceed $105,000. **Maturity indefinite.** Architect not appointed.

Conn., Wallingford—Masonic Charity Foundation, R. S. Walker, chn. Bd. Mgrs., Waterbury, postponed construction 2 story, basement, 50x135 ft., brick, rein.-con. nurses home and employes unit, W. T. Arnold, 487 Main St., Hartford, archt. Est. $105,000. Noted May 24.

Ind., Carmel—Sylvan Country Club, Hamilton Co., plans by F. B. Hunter, 924 Architect Bldg., Indianapolis, club, incl. swimming pool, $105,000. Site of 20 acres purchased.

Mass., Worcester—Clark University 950 Main St., revised plans by E. Kebbon, 522 5th Ave., New York, library. **Maturity about December.** Est. about $150,000.

Neb., Omaha—Creighton University, 25th and California Sts., plans by L. A. Daly, Insurance Bldg., constructing 2 new buildings, installing and power plant. To exceed $100,000. Noted Jan. 21, 1932.

N. Y., New York—Buildmore Constr. Corp., 110 West 47th St., plans by G. G. Miller, 10 West 47th St., 6 story, 148x153 ft. apartment, 266 St. Nicholas Ave.

N. Y., New York—Manhattan General Hospital, 159 East 90th St., plans 11 story, 75x100 ft. hospital, 149 East 90th St. $150,000 or more. Architect not appointed.

N. Y., New York—W. F. Weichbrodt, 34 Beekman St., will not alter elevator, boiler room, etc., in apartment, 32 Beekman Pl. $28,000. Project indefinitely in abeyance. O. A. Staudt, 45 West 52nd St., archt. Noted Aug. 9.

N. Y., New York—Public National Bank, 76 William St., soon lets contract 3 story, basement, brick, steel bank, 102 Orchard St. $200,000. Schwartz & Gross, 347 5th Ave., archts. Noted Sept. 27.

N. Y., New York—Bing & Bing, 119 West 40th St., plans by E. Roth, 18 East 48th St., 12 story, 100x100 ft., brick, steel apartment, 231 East 73rd St. $400,000.

N. Y., New York—Rockefeller Institute for Medical Research, York Ave. and 66th St., plans by Coolidge, Shepley, Bulfinch & Abbott, 1 Court St., Boston, Mass., 8 story, 113x207 ft. hospital and laboratory, York Ave. and 66th St. $1,500,000. **Maturity after Dec. 1.**

N. C., Salisbury—Building Committee Rowan Memorial General Hospital, comprising B. P. Beard, Dr. F. B. Marsh and J. E. Ramsey.

†*Federal Government.*

Commercial Buildings (Continued)

Salisbury, will appoint architect and make plans for new hospital. $115,000.

O., Cleveland—Memorial Sales Co., M. Helper, pres., 520 Cuyahoga Bldg., plans by Warner & Mitchell, Bulkley Bldg., 2 story, steel, stone, concrete chapel, S.O.M. Center Rd. $125,000.

O., Cleveland—Square Theatre Building Co., W. N. Skirboll, East 21st St. and Payne Ave., plans by J. Eberson, Inc., 370 Lexington Ave., New York, 1 story, brick, steel, concrete theatre addition, plain found., 1,700 seating capacity, Shaker Square. $150,000. J. L. Weinberg & G. B. Mayer, 1836 Euclid Ave., assoc. archts. Noted Sept. 13.

Ont., Toronto—Sisters of St. John the Divine, 38 Major St., plans by Mathers & Haldenby, 96 Bloor St. W., convalescent home and convent. $200,000.

BIDS ASKED

Calif., El Cerrito—Chung Mei Home, 3000 9th St., Berkeley, taking bids 2 story, rein.-con. home. $100,000 to $115,000. F. Reimers, 233 Post St., San Francisco, archt. Noted Feb. 22.

N. Y., Merrick—See "Contracts Awarded."

CONTRACTS AWARDED

Calif., Los Angeles—Graybar Electric Co., 301 East 8th St., 3 story, 100x150 ft., rein.-con. Class A building, 2nd St. and Santa Fe Ave., to Wm. P. Neil Co., 4814 Loma Vista St. Est. exceeds $105,000. H. T. Miller, 4814 Loma Vista St., archt.

La., New Orleans—Sisters of the Holy Family, 83x150 ft., rein.-con., brick boys home building, Gentilly Ave., to L. F. Favret, 937 Gravier St. R. L. Moroney, 8134 Sycamore St., archt.

N. Y., Merrick—Merrick Homes, Inc., group dwellings, Henry St. and Sunrise Hy., day labor and separate contracts. To exceed $100,000. Noted Sept. 27.

N. Y., New York—O. Wagner, trustee, I. H. Klinker Estate, 253 Bway., general contract altering, heating and plumbing in apartment, 993 2nd Ave., to Eberhardt Bros., 214 East 85th St. Est. $50,000. Contractor awarding separate contracts. Noted Sept. 20.

Tex., Dallas — Miss Ella Hockaday, 2407 Greenville Ave., for Junior College, 3 story, 47x140 ft., brick, stone, Greenville Ave., to P. D. Kosack, 5803 Bryan Parkway. $150,000 cost plus. Awarded Sept. 23. Noted Sept. 6.

INDUSTRIAL BUILDINGS

PROPOSED WORK

Ark., Camden — STORAGE — Ouachita Warehouse & Storage Co., foot of Washington St., plans repairing and altering cotton storage plant. $30,000 or more. Architect not appointed.

Calif., Stockton—CANNING PLANT—Pacific Can Co., 290 Division St., San Francisco, sketches rein.-con., steel canning and can manufacturing plant on 20 acre site, Industrial Area. Ellison & Russell, Pacific Bldg., San Francisco, engrs.

Ga., Monroe—STORAGE—Launius Bros. plans rebuilding storage, destroyed by fire. $30,000 or more. Architect not appointed.

Ga., Quitman—PLANT—J. W. Oglesby plans potato starch plant. To exceed $100,000. C. O. Herson & C. E. Drummond, Jr., 101 Spring St., Atlanta, engrs. and archts.

Ga., Savannah—BULK OIL PLANT—Colonial Oil Co., plans bulk oil plant, on Savannah River, near here. $95,000 with equipment.

Idaho — GOLD MINING DEVELOPMENT — Idaho Gold Corp., Boise, or c/o Miller Murry & Co., 444 Madison Ave., New York, plans gold mining development. To exceed $28,500. Project being financed by $337,500 stock issue.

Massachusetts—SUPER SERVICE STATION —Jenney Mfg. Co., W. A. Gott, ch. engr., 8 India St., Boston, plans three 1 story, 30x50 ft., brick super service stations and lubritoriums, concrete founds, heating, plumbing, electrical work, pumps, tanks, grease pits and pavement, at Gloucester, Newton and Wellesley.

Mass., Ayer—COLD STORAGE PLANT and WAREHOUSE—Nashoba Cold Storage Co., H. P. Gilmore, Westboro, sketches 3 story, 70x125 ft., concrete cold storage plant and warehouse. $75,000. Private plans. Bids in Spring.

Mass., Lynn — LABORATORY, etc. — Owner, c/o G. A. Cornet, archt., 14 Central Ave., making plan brick, concrete laboratory and garage. To exceed $28,500.

Mich., Detroit—PLANT—Cadillac Paint Co., 433 Leland St., plans repairing and altering plant, 433 Leland St., $40,000 or more. Architect not appointed.

Mich., River Rouge—FACTORY, etc.—Ford Motor Co., Schaefer Rd., Dearborn, making plans 40x150 ft., brick, steel, rein.-con. factory and power house, concrete pile found., small hydro-electric unit to be installed for power, air conditioning equipment, included, insulated roof and ceiling, Newburg Rd.; 1 story, 270x920 ft., brick, steel, concrete L-shaped steel mill, concrete pile or wood pile found. Giffels & Vallet, 604 Marquette Bldg., Detroit, engrs.

Nevada—MINING DEVELOPMENT—Amador Mother Lode Mining Co., c/o O. E. Chaney, pres., Reno, plans gold and silver lode mining development, various locations. To exceed $100,000.

N. J., Carteret—STORAGE PLANT—General American Tank Storage & Terminal, Carteret, and 122 East 42nd St., New York, plans 300,000 bbl. bulk storage addition. To exceed $100,000.

N. Y., Lewiston—STORAGE, etc.—Canadian Wineries Ltd., Stamford, Ont., Canada, plans expending storage facilities, from 100,000 gal. to 1,000,000 gal. $100,000-$150,000. G. Macy, c/o owner, ch. engr.

N. Y., New York—GARAGE, etc.—Worthen Realty Corp., 4720 Bway., J. Breen, treas., plans by N. Rotholz, 155 East 42nd St., 2 story, 100x100 ft., garage, repair shop, etc., 156th and Truxton Sts. $30,000 or more.

O., Cadiz — PLANT — Pittsburgh Industrial Iron & Coal Co., Pittsburgh, plans plant in Harrison-Jefferson Counties, near here, to work 1,200 acres of coal strippings. Equipment to be installed includes shovel and electric crane. To exceed $250,000.

O., Cincinnati—PLANT—Gulf Oil Refining Co., Gulf Bldg., Pittsburgh, Pa., soon lets contract 2 story, brick, rein.-con. storage building, 1 story, steel and galvanized drum and container washing building, also 1 story, brick, steel, concrete distribution building, 322 Beekman St. To exceed $30,000.

O., Cincinnati—POWER HOUSE—Kroger Grocery & Baking Co., 35 East 7th St., plans by Tietig & Lee, 34 West 6th St., 1 story, brick, rein.-con. power house, plain found., State St. $150,000. Fosdick & Hillmer, Union Trust Bldg., engrs.

Ore., Portland — STORAGE — Allis Chalmers Mfg. Co., 340 Belmont Ave., Portland, Ore., and Allis, Wis., plans rebuilding storage and distribution building. To exceed $30,000. Architect not appointed.

Va., Fredericksburg—SILK MILLS—General Textile Corp., Mills, Fredericksburg, plans rebuilding silk mills, replacing burned mill. To exceed $28,500. Loss $150,000. Architect not appointed. **Maturity later.**

Va., Port Royal—DISTILLERY—Blue Ridge Distillers, Inc., c/o A. G. Weaver, Port Royal, sketches distillery. $100,000.

Tenn., Chattanooga—WAREHOUSE—G. P. Russell, 3702 15th Ave., plans 2 story, basement, 60x120 ft., brick, concrete warehouse, concrete pile found., Rossville Blvd. Architect not appointed.

Tex., Lubbock—PLANT—Economy Mills plans rebuilding burned plant. To exceed $28,500. Loss $40,000. Architect not appointed.

Alta., Standard — LUMBER MILL — Atlas Lumber Co. plans lumber mill, storage, etc., here or vicinity. $50,000 or more. Architect not appointed. **Maturity indefinite.**

B. C., Burnaby—PLANT—Ford Motor Co., Ford, Ont., purchases site and plans plant. $250,000.

N. S., East Bay—MILL—Sheet Habour Lumber Co. Ltd. plans this year construction of mill. $50,000.

Ont., Goderich—PLANT—Goderich Mfg. Co., Wm. Baechler, mgr., plans rebuilding boiler house, saw setting rooms and 2 kilns with all equipment, completely destroyed by fire, $25,000 loss. Interested in prices new equipment in connection with same.

N. S., Falmouth—MILL—Baker Lumber Co. plans mill. $55,000.

Ont., Brockville—DISTRIBUTION PLANT—McCall-Frontenac Oil Co. Ltd., 360 St. James St. W., Montreal, Que., soon takes bids distribution plant. $35,000.

Ont., Ingersol—FLOUR MILL—R. A. Stewart, Sr., making plans flour mill. $100,000.

Ont., Sault Ste. Marie—FACTORY—Ontario Clay Corp. Ltd., c/o F. S. Stratford, mgr., 205 Vaughan Rd., Toronto, bids in about 1 month, constructing plant to manufacture alum at Sault Ste. Marie or **Kapuskasing.**

Ont., Toronto—MALT PLANT—A. B. C. Malting Co. Ltd. plans 1,000,000 bu. malt plant, incl. 110,000 bu. storage elevator, 142x69 ft. cleaning house, germinating building and kiln drying building. $200,000.

Que., Matane—SAW MILL—Price Bros. & Co. Ltd. plans saw mill. $35,000.

Que., Richmond—FACTORY—Dubois Knitting Mills plans factory. $40,000.

Que., Kimouski—SAW MILL—Price Bros. & Co. plans sawmill for hard woods. To exceed $30,000.

BIDS ASKED

Ariz., Tombstone—MINING DEVELOPMENT —See "Contracts Awarded."

Calif., San Jose—WAREHOUSE—C. McKenzie, archt., Twohy Bldg., taking bids 1 story, 126x165 ft., rein.-con., steel, Stockton Ave., for Muirson Label Co., 435 Stockton Ave. $38,000. Noted Sept. 27.

Mo., St. Louis—PACKING PLANT—H. Sokolik Packing Co., 1719 North Vandeventer Ave., taking new bids from selected contractors and will award contract about Oct. 10. 1 story, 79x46x18x31 ft., concrete, brick addition, Vandeventer and Cote Brilliante Aves. $45,000. Menges-Mange, Inc., 1515 North Grand Blvd., archts. Bids July 12 rejected.

Neb., Omaha—DRY CLEANING, etc.—Kimball Laundry and Zoric Dry Cleaners, 1504 Jones St., bids about Nov. 1. 1 story, brick building for enlarging dry cleaning department, and furnishing, installing cold storage equipment, 1504 Jones St., $38,500. J. Latcher, Sr., Insurance Bldg., archt.

N. J., Parlin—PLANT—See "Contracts Awarded."

CONTRACTS AWARDED

Ariz., Tombstone—MINING DEVELOPMENT —Mellgren Mines Corp., Tombstone, mining development, by day labor. To exceed $28,500.

Calif., Richmond—DISTRIBUTING PLANT—E. J. Freethy, general contractor, 1301 Roosevelt Ave., electrical work for distributing plant, to Pioneer Electric Co., 111-3 Macdonald Ave., Richmond, for Mohawk Oil Co., 405 Montgomery St., San Francisco. Noted Sept. 27, under "Contracts Awarded."

Conn., Norwich—OIL TERMINAL—American Oil Co., Park Row, Hartford, constructing 300 ft. rein.-con. retaining wall, 1 ft. thick with 1x5 footing, two steel tanks with concrete founds. and building, to Peck McWilliams Co., West Main St. Est. $18,000. Private plans.

D. C., Wash.—STORAGE, etc.—Peoples Drug Stores, Inc., storage and distribution, to E. A. Haissip, 426 Crittenden St. N.W. To exceed $28,500.

Ind., Evansville — PACKING PLANT — Weil Packing Co., Evansville, 2 story, basement, 80x80 ft., brick, rein.-con. addition, to Scarborough-Thrash Co., Evansville, $75,000. Noted Aug. 16.

Mass., Lawrence—GARAGE—Nevins Auto Co., 400 Bway., 1 story, 70x140 ft., brick, steel garage addition, West St., to A. Champy & Sons, 20 Fitz St. Est. $35,000. Awarded Oct. 1. Noted Sept. 13.

Md., Baltimore—GRAIN ELEVATOR—Southern States Co-Operative Mills, 2101 East Fort Ave., grain elevator workhouse, storage annex, structural steel feed storage annex, etc., to Rust Eng. Co., Koppers Bldg., Pittsburgh, Pa., approximately $63,000. Noted Oct. 4.

Mich., Detroit — TOBACCO WAREHOUSE — Scotten-Dillon Co., 4085 West Fort St., 2 story, 140x180 ft., brick, steel, rein.-con., plain found., Fort St., to H. T. Wunderlich, 2411 14th St. Est. $50,000. Donaldson & Meier, 1601 Washington Blvd. Bldg., archt.

N. J., Parlin—PLANT—Hercules Powder Co., Wilmington, Del., constructing plant for manufacture of Tornesit, separate contracts.

O., Cincinnati—GRAIN ELEVATOR—Early & Daniels Co., c/o K. Early, constructing rein.-con. and steel grain elevator, 199 ft. high to handle 10,000 bu. grain daily, to McDonald Eng. Co., 1 La Salle St., Chicago, Ill. Est. $100,000. Awarded Sept. 26. Noted Aug. 23.

O., Cleveland—FOUNDRY—Aluminum Co. of America, J. P. Dearasaugh, constr. engr., 2210 Harvard Ave., structural steel for 1 story, 85x100 ft. brick, steel foundry, 2210 Harvard Ave., to Republic Structural Iron Wks., East 31st St. Total est. $35,000.

†*Federal Government.*

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